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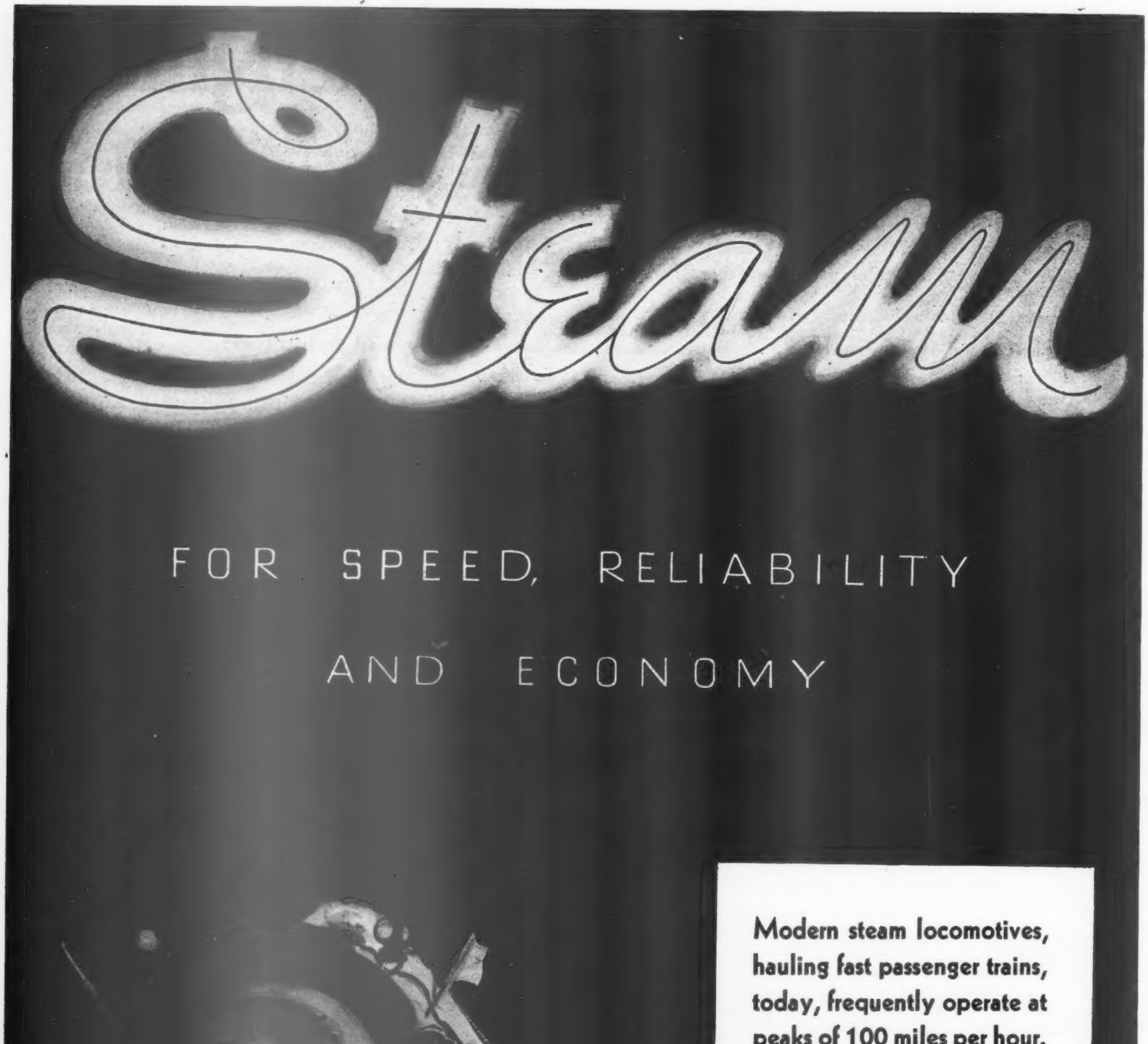
Steam
FOR SPEED, RELIABILITY
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Modern steam locomotives, hauling fast passenger trains, today, frequently operate at peaks of 100 miles per hour.
Modern locomotive engineering can supply steam locomotives capable of hauling passenger equipment at 120 miles per hour and without introducing any unproven elements.
If passengers want high speed give it to them with steam power and thereby obtain a maximum of safety.
LIMA
LOCOMOTIVE WORKS
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Railway
Mechanical Engineer

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May - 1934

Diesel Engines for Locomotives and Cars*

By R. Tom Sawyer†

Highly developed specialized designs of Diesel engines provide economical and reliable power units for locomotives and rail cars

THE first Diesel engine which was originated in Germany by Rudolf Diesel had the same fundamental principles that it has today; that is, it burned fuel oil and required no spark plug for ignition. The fuel oil is ignited by simply compressing the air to a very high temperature. A Diesel locomotive is a locomotive which contains one or more Diesel engines, power being transmitted electrically or otherwise to the driving wheels. The fuel oil universally used today is partially refined for this particular purpose and is similar to that burned in the oil furnaces in houses, being a higher grade than that used in oil-burning steam locomotives.

The overall thermal efficiency of the engine is between 20 and 35 per cent, depending upon the service and type, the thermal efficiency of a Diesel locomotive being considerably higher than any other practical type of locomotive known. Tests show that the Diesel locomotive will use only one half as much fuel as a gasoline locomotive and only one fifth to one tenth as much fuel as an oil-burning steam locomotive in the same service.

Engines for automobiles, rail motor cars and Diesel locomotives are similar—all three use the four-cycle engine—the only difference being the fact that the Diesel engine burns fuel oil instead of gasoline and the fuel oil is injected directly into the cylinders instead of sucked up through the carburetor as gasoline is in a gasoline engine. The Diesel engine is not a mystery to those who once understand that it is similar in construction to a gasoline engine, but far more economical and rugged as required for railroad service.

Progress in Development

There is a very definite place for the Diesel locomotive in the railroad field. That place is primarily in switching and transfer service. The time may come, however, in which it will replace the steam locomotive to a greater extent than now seems probable. I, personally, look forward to an overlapping of various types of motive power so that no one type will ever be universally used for all forms of transportation.

There are close to 1,000 gasoline rail cars and over 100 Diesel locomotives in service in this country today. They all use internal combustion engines.

Four years ago I visited several bus and truck manufacturing companies in England and at that time asked why they did not use a Diesel engine, as the price of gasoline there was abnormally high. In one factory the assistant general manager in answer to that question gave 18 different reasons why a Diesel engine could not be used in a bus. Some of his reasons were that it was too heavy; it smoked; the odor was too smelly and it didn't have the power. Last summer I visited the same factory again. The same man took me through the same shop and there in the production line of engines coming through were Diesel engines only, the type which four years ago was condemned as impractical. This engine was not too heavy; did not smoke; did not have any bad odors, and had the same horsepower as the gasoline engine which it replaced. This engine is now used in over 100 London buses. It is slightly heavier than the gasoline engine formerly used, but not too heavy; it costs considerably more than the gasoline engine, but the saving by using fuel oil amply justifies the higher first cost. The situation in other factories visited was similar—practically the whole production having been switched from the gasoline engine to the Diesel.

A typical four-cycle Diesel engine weighs only 11 lb. per hp., including all auxiliaries, or less than any two-cycle engine that I know of for railway service. Many early automobiles had two-cycle engines; today the automobile universally uses simple four-cycle engines. In 1917 the largest builder of gasoline rail-car engines at that time brought out a two-cycle Diesel engine, but today the four-cycle engine still leads and should con-

* Abstract of a paper presented before the meeting of the Western Railway Club held at Chicago, April 16, 1934.
† American Locomotive Company.

tinue to lead in railway service, due to its simplicity of maintenance and operation.

In this country the first Diesel locomotive was sold in 1925 to the Central Railroad of New Jersey. That was only nine years ago. That particular Diesel locomotive has given exceptionally good results when we consider that it was the first.

Types of Transmission for Diesel Locomotives

The question is often raised as to what type of transmission should be used in transmitting the power of the Diesel engine to the driving wheels. The electric drive has been universally adopted for heavy switching Diesel locomotives, while the mechanical drive is generally used in the small industrial locomotives of 20 tons or less. In addition to electric transmission there are four other means of transmitting the power.

One type is a mechanical drive, similar to that of an automobile using a friction clutch and gear box. For small locomotives this transmission is satisfactory. Another type is the direct mechanical drive where the clutch and gear box are eliminated; that is, the Diesel engine is connected directly to the driving wheels. The first locomotive of this type was built in 1912 in Switzerland and proved unsatisfactory. Another locomotive is now in trial service in Germany. In both cases the locomotives are started by compressed air and, naturally, starting the locomotive means starting the Diesel engine together with the entire train. I mention this type of drive because it appears to be the simplest type to build and of interest to watch.

A third type of air transmission; that is, the Diesel, is coupled directly to an air compressor which supplies air to drive the pistons in the cylinders placed on the locomotive in the same manner as steam cylinders on a steam locomotive. Up to date none of these locomotives has been successful. This is true also of the heavy duty locomotives using hydraulic transmission. Electric transmission is generally preferred today in this country, especially in heavy switching service where the locomotive is continuously starting and stopping. However, the Diesel has really not entered the field of pulling heavy fast freight trains, but when—and please note that I did not say if—that day comes there may be a question as to what type of transmission or arrangement of engine should then be used.

Comparative Characteristics of Diesel-Electric and Steam Locomotives

The question is often asked "Why does the tractive force of a Diesel-electric locomotive drop so rapidly?" The answer is that the horsepower of the Diesel engine is constant regardless of the speed of the locomotive, due to the fact that the power is supplied through electric transmission. The cylinders of a steam locomotive are coupled directly to the driving wheels and for this reason the steam locomotive may have a small horsepower in starting but additional power is developed rapidly as the locomotive picks up speed. This is a fundamental fact which we must understand in order to appreciate the difference between a steam and a Diesel-electric locomotive. That is the reason why a Diesel locomotive which has only 600 hp. can do a better job in switching service than a steam locomotive which may have 2,000 hp. at 30 m.p.h., as in yard switching service the operating speed seldom exceeds 10 m.p.h. and within this speed the steam locomotive actually develops less horsepower than the Diesel locomotive.

Comparing the acceleration curves of a 75-ton steam locomotive and a 600-hp. Diesel locomotive (both suitable for switching service) handling a train of 1,000 tons. It is found that the Diesel locomotive gives an appreciably better performance up to 10 m.p.h. For example, it takes only 19 sec. for the Diesel locomotive to reach 6 m.p.h., while it takes 8 sec. longer for the steam locomotive to reach the same speed. However, the steam locomotive has a better performance above 10 m.p.h. and is, therefore, better suited for transfer and road service with this particular size of train.

Operating Costs

If a Diesel locomotive can be placed in approximately 24-hr. switching service it will more than justify its higher first cost regardless of the type and size of steam locomotive replaced. There may be exceptions, but as yet we have not found any. However, if the Diesel locomotive is to be operated approximately only 16 hrs. a day the costs should be analyzed to determine whether steam or Diesel is most economical. Generally speaking, it has been found that the Diesel engine is justified if placed in 16-hr. service, 6 days a week and as many as 300 days per year.

Cost of repairs varies greatly even on steam locomotives in the same class of service on different roads, and, therefore, it is extremely difficult to state what the costs of repairs will be on Diesel locomotives on a certain road even though we know what their costs are on a neighboring road. It is fair to assume that the cost of repairs is equal to or less than the steam locomotive. It can be assumed that the miscellaneous expense of the Diesel locomotive is equal to the miscellanous expense of the steam locomotive.

The cost of lubricating oil for a Diesel locomotive is greater than for a steam locomotive and, on the other hand, the water consumption on a Diesel is negligible. It is of interest to note that service data show the lubricating oil cost of a Diesel locomotive is generally equal to, or less than, the combined cost of lubricating oil and of water on the steam locomotive which it replaces.

Therefore, we have only three factors which vary appreciably. The cost of fuel on the Diesel locomotive is far less than the cost of fuel on the steam locomotive, whether it burns coal or oil. The cost of labor is considerably less on the Diesel locomotive, because there is not one Diesel locomotive in service in this country that uses a fireman; there is no work for the fireman and, therefore, no need or reason for having one. In a few cases a second man in addition to the engineer is used on the Diesel locomotive, but in no case is a fireman required or used. The third factor is enginehouse expense. This expense covers two sub-factors: First, the overhead cost of the enginehouse and, second, the cost of work on the locomotive when it is in the enginehouse. The overhead cost cannot be changed, generally speaking, whether steam or Diesel locomotives, or both, are used, yet if the Diesel locomotive is kept in 24-hr. service six or seven days per week it seldom enters the enginehouse and, therefore, cost of actual work on the Diesel locomotive is considerably less than that on the steam locomotive.

There are many incidental savings obtained by using Diesel locomotives which cannot be so directly accounted for. These savings are, however, real and include track maintenance to some extent, elimination of water and coaling facilities and elimination of double heading in certain cases where the high starting tractive force of the Diesel locomotive has an advantage over the steam locomotive. There is also, in some cases, a saving due to the fact that the Diesel locomotive can enter factories and warehouses where the steam locomotive is required to stay out and use reachers consisting of a string of cars to enter the building.

There is now a considerable amount of real operating data available as to the Diesel and, with service condi-

tions specifically outlined, accurate comparative costs of Diesel and steam locomotives can be made. The decision as to whether the Diesel or steam locomotive is purchased should be based on an analysis of these comparative costs.

Diesel Engines for Rail Motor Cars

There are today approximately 1,000 gasoline rail cars in service in this country and these have played an important part in the development of the Diesel locomotive. These rail cars have proved that there are at least some cases where more economical power than steam can be used. Although steam locomotives are generally employed, something else should be used when it is more economical. The rail car has also served to take away the mystery surrounding the internal-combustion engine and has taught the steam man how to operate and maintain internal-combustion engines in railroad service and, incidentally, has shown him their advantages and economical benefits. The Diesel is to the mechanic simply a glorified, simplified gasoline engine.

The era of the single-unit rail car is passing; it was put in as a stop gap to reduce losses. The car and the branch over which it operated will in many cases be abandoned. Rail-car development is toward more capacity, more speed, and is leading up to the new high-speed articulated units operated with internal-combustion engines as the power. These new units, in a new field, are closing the gap between the branch-line rail car and the high powered steam passenger locomotive. Just a word as to the power to be used by these units and the future higher powered rail cars, or locomotives. There can be, in the light of today's developments, but one forecast and that is that the Diesel engine will be used practically exclusively where steam does not continue to hold its preeminence.

Multiple-Unit Diesel Trains Suggested

Many of you may not appreciate the fact that there was a day when competent engineers said that multiple-unit electric trains could not be operated successfully; that trains similar to the Chicago electric elevated lines as operating today were not practical. The first elevated trains in Chicago were pulled by steam locomotives, then by electric locomotives, and later, here on the South Side Elevated, Frank Sprague first proved the practicability of his multiple-unit invention. A multiple-unit train is a train that has the driving power placed on each car, or on every other car as the case may be, and where the motors on all cars are controlled from either end by one master controller.

Multiple-unit electric car operation is now almost universal. There are about 10,000 such cars in service today in this country. The traction motors are on individual cars, but all can be controlled from any car in the train. With this remote control the electric cars have real flexibility. Each car can be moved as an individual unit and the number of these individual units which can be coupled together in a train is practically unlimited.

The Diesel locomotive or rail car is operated from a control stand. There is no reason why a similar control stand cannot be in a distant car with small electric control wires in a jumper connection between the cars similar to the jumper connections on the electric multiple-unit trains. These small electric control wires running throughout the train would control the Diesel engines located on the individual cars from the control stand in the front car. This is practical and opens up an enormous field of possibilities. Such an arrangement, with suitable couplers, is used on Diesel-electric multiple-unit cars of the Netherland Railways.

We could take a single car, equip it with a Diesel power plant of say 400 hp., and with a suitable electric transmission that car could be operated at, say, 80 m.p.h. between New York and Chicago. Now visualize 10 or more of these motor cars each with a trailer, coupled together in one train and all controlled electrically from the front car and you have a picture of future possibilities.

This arrangement would solve one great problem—a perplexing one which is confronting steam railroads today. The question is how large shall one Diesel power plant be to handle an entire train; shall it be 1,000 or 2,000 or even more horsepower? Would it not be much simpler from an operating standpoint to discard the one big Diesel power plant and place a small power plant on each car? Then it would make no difference whether there be six cars required in train No. 1 today or 16 cars in the same train tomorrow.

Rail cars or streamlined Diesel trains of today operate independently. However, Diesel multiple-unit cars must be built so as to be interchangeable and operate on any road; that is, a standardized air brake system should be used, as is now used on all passenger cars today; standard M. C. B. couplers; a standard control should be decided upon—a simple control—so cars manufactured by different companies can operate in the same train.

This is not a new idea, for it has been tried with gaso-

A 600 hp. Diesel-electric locomotive built by the American Locomotive Company for the Delaware, Lackawanna & Western

line engines. A good Diesel engine should require no personal attention when in operation. When this thought of using multiple-unit Diesel cars is given consideration one immediately realizes that a Diesel propelled train of even 4,000 hp. is available today. The cost of such a train brings on the old adage: "More expenditure means greater production and high production means low cost." There is practically no limitation to the operating range of the Diesel multiple-unit train, for regardless of the size it would have ample power to operate on a fast schedule from Chicago to St. Louis, New York or California.

Freight Train Service

Although multiple-unit Diesel freight trains as a future possibility would open up an interesting discussion, I am not going into that field tonight. I simply wish to point out that multiple-unit Diesel freight trains are a practicable possibility. On electric interurban lines freight trains are not generally hauled by electric locomotives, but are handled by one or more freight cars equipped with electric traction motors. If these same cars were equipped with Diesel power plants they could be operated on any steam road. With but few exceptions the rail car in this country, until now, has been applied primarily to passenger service. However, in Germany there are a number of installations where the Diesel rail car is used exclusively for freight service. Here is a virgin field, a field to which practically no serious consideration has been given; that is, the application of the Diesel freight car.

In order to improve service in the future you are told you must speed up your service. I am naturally biased in favor of the Diesel, but the call for the Diesel is not due to the need for more speed. Twenty, yes thirty, years ago the steam locomotive was operated at as high a speed as a passenger-carrying train on rails should be operated today. More power or change of design can overcome the added wind resistance, but we must recognize rail limitations. No locomotive can, or rather no locomotive should, attempt to pull a train faster than the rails can carry the load safely. The call of the day is for something different; something more economical, something more attractive, but not necessarily more speed.

The steam locomotive has been brought up to its present high standard only after a century of experience in actual service. The Diesel locomotive of today has passed through only nine years of actual service in this country. In 1925 many railroad men ridiculed the Diesel locomotive. Today, all thinking railroad men recognize that there is a legitimate, economical field for the Diesel; the only question is what are its limitations. It has come a long way in nine years and to my mind it is just well started.

Comments by W. L. Garrison*

The original specifications for the first Ingersoll-Rand Diesel engine for railroad application were drawn up 14 years ago. After 10 years service experience with 125 of these engines in various classes of switching, transfer and branch line service, operating records show that original requirements were correct both as to detail and order of importance. For railroad service these specifications demanded positive requirements from the oil engine and their order of importance was and still is as follows: 1. Reliability. 2. Good balance. 3. Relatively high speed and low weight. 4. Accessibility with low maintenance. 5. Absence of noise and smoke. 6. Reasonable fuel economy. 7. Reasonable lubricating oil economy. 8. Reasonable first cost. If the Diesel engine is to justify its existence against the modern steam locomotive and continue to maintain its place in railroading, it must have reliability and low maintenance even though it costs more to build such an engine. Otherwise the Diesel locomotive cannot save enough in operating expenses to return a profit over its annual capital charges.

Consider the various demands made upon the locomotive oil engine. Experience has shown that the engine must meet successfully three different classes of service, each placing different demands upon the oil engine. These are: 1. Switching service. 2. Main line passenger or freight service. 3. Combination three-power locomotive service.

In switching service the oil engine operates 20-24 hours per day at variable speed. The engine is under almost constant acceleration and deceleration from no load idling to full load maximum speed, and must be capable of steady performance 6,000 to 7,000 hours per year. In this service the average load factor is low, from 12 to 25 per cent but the maximum power output may be demanded instantly and at frequent intervals.

The Diesel-electric rail car is characteristic of main line passenger service in which the engines operate from 12 to 17 hours daily at more nearly constant full load speed except for short intervals of coasting down grades or idling at station stops. The engines must be capable of sustaining full horsepower output over long periods, averaging as high as 70 to 85 per cent load factors if operating schedules are to be consistently maintained. For the past 15 months we have had a 600-hp. oil-electric rail motor car in revenue service on ten different railroads handling from one to five heavy trailers under all kinds of branch line, local and express service. Meter and time records of the engine and car performance have been kept from the start. The demands on the oil engines in this service are the same as those for large main line freight or passenger locomotives.

The so-called three-powered or oil-electric-battery combination locomotives are special both in service and in demands on the Diesel engine. Since the engine must supply electrical current for both the traction motors and charging the storage batteries, it must operate at constant full speed instead of variable speed under high load factors of from 50 to 60 per cent. Hours of service average from 5,000 to 7,000 per year although the engines get some respite since they may be shut down while the locomotives are operating on the third rail.

In addition to these service demands, railway Diesel engines must be strong enough and rigid enough to maintain alinement of their working parts and withstand the strains imposed by the flexibility of the locomotive or car frame. They must operate with no attendance and a limited supply of cooling water to dissipate the heat from cylinder heads and combustion chambers. Railroad service is far more exacting than either stationary or marine service.

Since locomotives and motor cars must have a reasonable weight for traction, safety and comfort, isn't it demanding too much of the Diesel power plant, which daily propels this equipment, to reduce its weight to a minimum, boost its rotative and piston speeds to a maximum and raise its brake mean effective pressure materially expecting at the same time long life in continuous operation, reliability and low maintenance.

A Diesel engine for railroad application should be good for a useful life of 25 years at 6,000 to 7,000 operating hours per year. This represents approximately 150,000 to 175,000 hours of operation which in itself is no mean task compared with that required of marine,

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automobile or aeroplane engines. An automobile engine may have a useful life of 150,000 miles. At an average car speed of 20 miles per hour, that is only 7,500 hours of actual operation or one year service in railroading.

Comments by H. K. Smith*

The Westinghouse Electric & Manufacturing Company has been interested in the development of Diesel engines for railway service for a number of years and has developed a standard line of four-cycle engines based on a 9 in. by 12 in. cylinder and an engine r.p.m. of 900. This gives 66⅔ hp., from each cylinder, so we have in four-, six-, eight- and twelve-cylinder engines, 265, 400, 530, and 800 hp. With twin power plants of these sizes you can go up to 1,600 hp. We believe there will be few applications in the near future, for locomotives of greater horsepower than this. For main line and some transfer service more horsepower will be required but this can be obtained without larger engines by multiple operation. Incidentally, all these engines use the same pistons, liners, fuel pumps, and many other parts.

Our experience has been that with 9 in. by 12 in. cylinders and 900-r.p.m., engines with sufficient weight can be obtained to meet the ruggedness so necessary for railway service and with dimensions and weights well within the limits required for rail car service. The weight per brake horsepower is approximately 30 lb. With the aluminum pistons used it is feasible to lift out a piston and connecting rod without resorting to special lifting equipment; the piston and rod weigh about 90 lb.

The Westinghouse Company has expended considerable time and money experimenting with two-cycle engines. As has been brought out, there are various two-cycle engines in service today, particularly of the lower speed stationary type. The question is, is it possible when everything is considered, to get a more economical engine with the two-cycle principle than with the four-cycle principle which has been so successful in railway service? A possible advantage for the two-cycle engine is in a streamlined train where the light weight and space limitations are severe. I believe the complete Diesel-electric power plant with a two-cycle engine will not be as efficient as with a four-cycle engine, and it is questionable whether the weight and space saved can be justified.

We have also done some work with super-charging, and this offers a fertile field for the development of greater capacity for a given piston displacement.

* Westinghouse Electric & Manufacturing Company.

Comments by E. F. Kultchar*

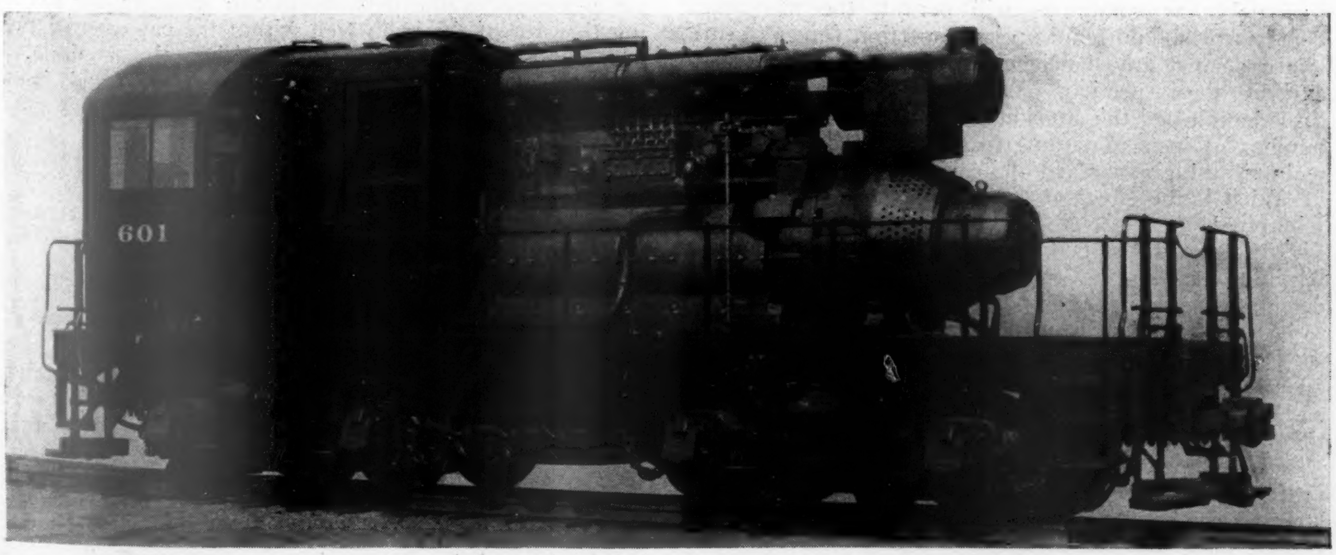
An argument regarding the merits of two- and four-cycle engines probably should have no place in a discussion of this paper, but this is necessary to avoid an incorrect impression. I believe it is generally recognized today that there is nothing inherent in either the two-cycle or four-cycle design which should condemn a Diesel engine for any job for which it is otherwise adapted. Either type, if a thoroughly-proven product, and if manufactured by a reputable company experienced in the Diesel engine field, may be depended upon.

The greatest advantage of the two-cycle engine is quite generally recognized to be its relative simplicity. As compared to the four-cycle, the two-cycle eliminates intake and exhaust valves and the rockers, push rods and cams required for operating them. For this valve mechanism which, under the high pressure and temperature conditions existing in a Diesel motor, must be maintained in practically perfect condition and adjustment, there are substituted, on the two-cycle engine, ports in the cylinder walls which are uncovered by the piston and a low-pressure air blower or pump to maintain about 3 lb. pressure on the manifold which connects the air intake ports. Other engine parts are common to both types. Advocates of the two-cycle maintain that the resulting simplicity offers advantages in the form of increased reliability, shorter shut-downs for inspection and maintenance, and lower maintenance cost. That this belief is justified by experience is evidenced by the rapid increase in the sale of two-cycle engines as compared to the four-cycle. In 1921, 15 per cent of the total Diesel horsepower sold in this country were of the two-cycle type and in 1931, 61.2 per cent.

It is logical to ask why anyone should build four-cycle engines with their comparative complications. Except for engines with small cylinders operating at high speed, say 1,000-r.p.m. or higher, in which the requirements for metering the fuel, i.e., governing, are at the present time beyond the possibility of such mechanism for two-cycle engines which have a much smaller fuel charge than four-cycle engines due to their being twice as many, there does not seem to be justification for the four-cycle

* Fairbanks, Morse & Company.

(*Concluded on page 156*)



A 600 hp. Diesel-electric locomotive built by American Locomotive Company with engine housing removed

Regaining Lost Passenger Traffic

Mechanical department can assist materially in a number of different ways

PASSENGER traffic on the railways of the United States has decreased at an alarming rate since 1920. It had grown at a rapid pace from 1915 until 1920, when it reached its apex of 46.8 billion passenger-miles. The private automobile, the bus and the airplane made heavy inroads into it in the years following and the situation has been further complicated in more recent years by the depression. The revenue passenger-miles in 1933, for instance, amounted to 16.2 billion, as compared to a five-year average, 1925-29, of 33.5 billion, a reduction of approximately 50 per cent. The year 1933, however, will probably go down in history as marking the turning point in the start to regain this lost business.

The problem is being attacked vigorously in many ways, one important means being to improve the comfort and convenience of travel by improved appointments in the passenger train cars; also by the smoother and better handling of trains. Passenger traffic officers are enthusiastic over improvements which have been made in the equipment by the mechanical department, such, for instance, as air conditioning, improved lighting, more comfortable seats, easier riding equipment, etc.

Build Up Inspection Forces

What other things can the mechanical department do to assist in regaining lost passenger traffic? This is the question I put to a Passenger Traffic Official of a road which is noted for the high standard of its passenger service. He had no advance information as to what I wanted to see him about. His reactions were immediate, however, and very much to the point.

"Under the difficult conditions through which we have been passing," replied the Railway Traffic Officer, "it has been necessary to reduce expenses to a very minimum. The mechanical inspection forces at the division points, as in all other departments, have been hard hit. It is true that we have been extremely careful with our smaller inspection forces to maintain high standards from the standpoint of safety and prevention of accidents. On the other hand, the smaller forces have made it necessary to ease up on some details which do not affect the safety, and yet which are quite likely to prevent or overcome deficiencies which are irritating to the passengers and may result in delays in operation. Just as quickly as conditions will permit, the mechanical department should build up its inspection forces to safeguard against any deficiencies of this sort and also to expedite the inspection. As it is now, we have in some cases lengthened the stops at stations to give the smaller number of inspectors time to get over the ground and maintain a high standard of inspection."

"What is the effect of lengthening stops at stations?" I inquired.

"Not so good," replied P. T. O. "The average traveler, when he gets started on the train, wants to get to his destination as quickly as possible, and he is quite likely to become impatient at prolonged stops at stations."

"Does this mean, in your opinion, that we ought to operate our trains at higher speeds?" I asked.

"Not necessarily," replied P. T. O., "but it does mean that we ought to do everything possible to keep the wheels rolling. While some of our passengers may prefer higher speed trains, many of them, and particularly the women, prefer a medium speed. You must realize, also, that the time between terminals for many of our trains can be considerably lowered on some runs by reducing the length of time standing at intermediate stations."

Dimming Lights at Night

"Have you anything to suggest concerning passenger coaches, for such travel would seem to be of vital importance in building up the passenger business and revenues?"

"In general," replied P. T. O., "the mechanical department has made an excellent job of improving the comfort and conveniences in the passenger coaches, as well as improving their riding qualities. We must not forget that many of the coach travelers spend the night on the train and we must do everything possible to make the riding comfortable and give them an opportunity to rest. We cannot put out all of the lights and some passengers are annoyed, even if most of the lights are put out, if a few still remain brightly lighted. The mechanical department can make quite a contribution if it can find some way of dimming the lights which remain lighted. Technically, I imagine this is not a difficult job, because we see applications of it in both home and theatre lighting.

Eliminate Rough Riding

"There is another phase of passenger train operation that cannot be too strongly emphasized," continued P. T. O. "I cannot understand, for instance, why some trains can be operated smoothly and without jolts, whereas other trains with similar locomotives and the same number of cars are handled so roughly as to provoke comments on the part of passengers. It looks to me as if this is purely a matter of craftsmanship and that adequate training and educational methods, with discipline it necessary, can be applied so that all of the enginemen can give the same high grade of service that some of them do. I realize, of course, that if a locomotive is overloaded it is difficult or even impossible to prevent a certain amount of rough handling, but we in the passenger traffic department are strongly for keeping the size of the train well within the capacity of the locomotive to handle smoothly. When this is done it seems to me that there is no excuse for the rough handling of passenger trains, particularly since it does provoke criticism on the part of the passengers."

Air Conditioning

"What in your opinion is the most important contribution that the mechanical department has made in passenger train cars within recent years?"

"By long odds, the application of air conditioning," replied P. T. O. "This is certainly the greatest improvement that has been made in passenger traveling in the past quarter century. Controlling the temperature and the moisture content of the air is only part of the excellent results secured. The elimination of dirt and cinders and the great reduction of noise inside the car have added much to the comfort of the traveler. In my opinion, this feature, together with other conveniences that have been added to the equipment, will be most helpful in assisting to regain passenger traffic."

High-Speed Stainless-Steel Train Built for the Burlington

The streamlined "Zephyr," built by the Edward G. Budd Manufacturing Company's Shotweld process, weighs 195,000 lb. With 600 hp. at the generator it exceeded 100 m.p.h. on its trial runs

THE Burlington Zephyr, built by the Edward G. Budd Manufacturing Company, Philadelphia, Pa., was christened before a party of invited guests at the Broad Street Station of the Pennsylvania Railroad at Philadelphia, Pa., on April 18, following which it started on an exhibition tour of eastern cities. This will be followed by a similar tour of the west before the train is placed on exhibition for the summer at A Century of Progress Exposition, Chicago. It was built specifically for a round-trip daylight run between Kansas City, Mo., Omaha, Neb., and Lincoln, on which it will be placed in the fall.

The Zephyr is a three-car articulated train of light-weight stainless-steel construction, with smooth stream-lined surfaces to permit of high-speed operation. It is powered by a 660-hp. Winton Diesel-electric power plant, and on its trial run developed speeds in excess of 100 miles an hour on level track with no wind. Wind-tunnel tests of scale models conducted at the Massachusetts Institute of Technology indicate that at an operating speed of 95 m.p.h. the resistance to motion should be reduced to about 47 per cent of that of a train of three coaches of conventional shape, but of equal weight.

The train consists of three car bodies carried on four trucks and is approximately 197 ft. in length. In the first car, aside from the operator's cab and the engine room, there is a 30-ft. mail compartment and a short baggage compartment, which is continued at the front end of the second car body. These two compartments are designed to carry 50,000 lb. of baggage and express. Seats for 72 passengers are provided at the rear end of the second and in the third car bodies, of which 12 are in the solarium lounge at the rear end of the train. The buffet-grill in the second car provides light meals which are served at the seats in the passenger compartments.

Shotweld Stainless-Steel Construction

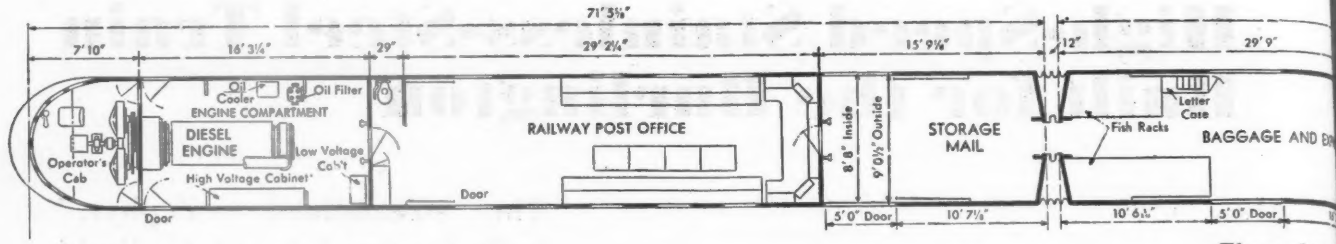
The truss form of construction which has been developed by the Edward G. Budd Manufacturing Company for the utilization of built-up sections of thin-gage stainless steel, joined by the Shotweld process, is used in the car-body structure and, to a large extent, the entire body structure, from floor to roof, performs load-carrying functions. The truss members are generally of flanged box sections formed of deep channels and cover plates joined by Shotwelds. The stainless steel (18 per cent chromium and 8 per cent nickel) by which these sections are formed has a minimum tensile strength of 150,000 lb. per sq. in. and an elastic limit of 120,000 lb. per sq. in., with satisfactory ductility.

One of the illustrations shows a specimen of a section originally 14 in. in length tested to destruction in compression and reduced to a length of 6¾ in. without a break in the material. This member, of material 0.050 in. thick, has a sectional area of 0.51 sq. in. and weighs 1.77 lb. per lineal foot. Its moment of inertia is 0.35 in.^{4} about either axis, and its radius of gyration is 0.8 in. It withstood under compression 36,000 lb., or over 70,000 lb. per sq. in. After failure had started the load required to continue the destruction varied up to a maximum of 28,000 lb.

The tenacity of the welds is also clearly indicated in the illustration of the failed specimen. The Shotweld process, developed and patented by the Edward G. Budd Manufacturing Company, effects a specific regulation of

Photo by Wendell MacRae, New York

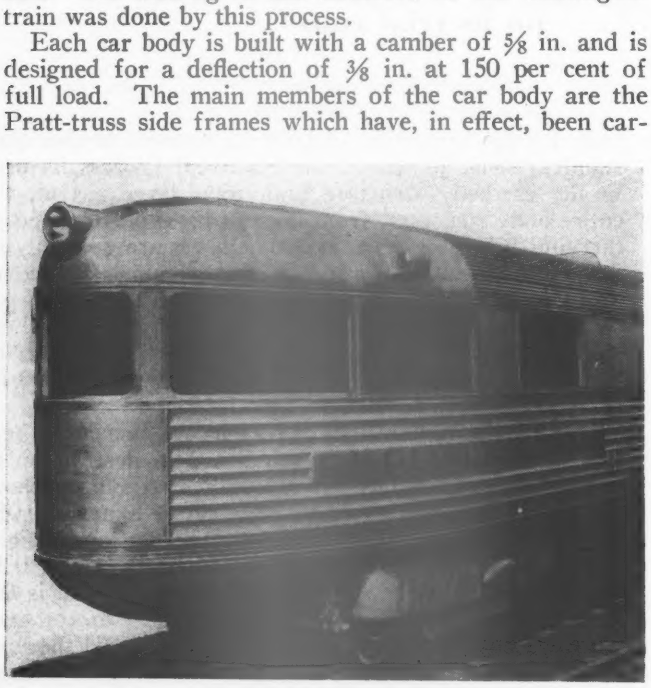
The Burlington Zephyr



Floor plan o[...]**lington Z**

the pressure, the electric current value and the duration of its flow, thus maintaining unimpaired the strength and corrosion-resisting properties of the material. The welds develop a shearing strength of 75,000 lb. per sq. in. and will withstand torsion up to 90 deg. before rupture. All welding in the structure of the Burlington train was done by this process.

Each car body is built with a camber of ⅝ in. and is designed for a deflection of ⅜ in. at 150 per cent of full load. The main members of the car body are the Pratt-truss side frames which have, in effect, been car-



Exterior of the observation-lounge

ried up to the roof by the use of diagonals in wide deadlights between the windows and of which the roof forms a part of the top chord. The floor structure is made up of a corrugated sheet of stainless steel, the bottoms of the rectangular corrugations of which are welded to a flat sheet and both in turn welded to the longitudinal stringers, of which there are eleven across the car. These, in turn, are secured to transverse supports built into the car frame. The floor thus forms a stiff horizontal girder through which end loads are distributed to the side girders. In the baggage compartments it is designed for a loading of 600 lb. per lineal foot.

The roof constitutes a primary structural member assuming the compression load. It is built-up of longitudinal corrugated sheets welded to roof carlines and is locally reinforced at points of maximum stress. The roof-sheet corrugations are 7/16 in. deep, with a pitch of 1½ in.

The enclosure below the floor is of only incidental value as a part of the load-carrying structure and the trussed center sills are designed primarily to serve as means of attachment for apparatus, to stabilize the floor beams and to serve as local reinforcement.

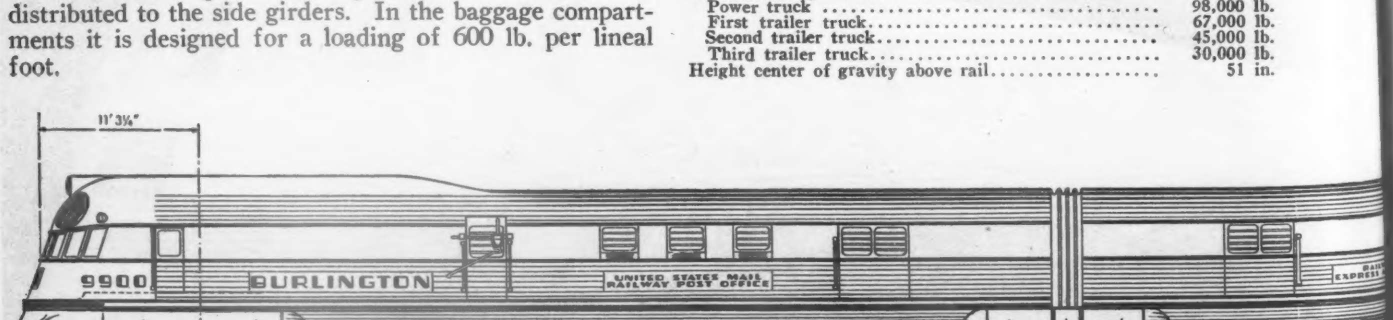
Special Features of the Body Construction

The engine-bed, fabricated by Lukenweld, Inc., is a rigid arc-welded structure of steel plate, annealed after completion of the welding. It forms a combination bumper, engine bed and bolster and is 25 ft. 3½ in. long, by 8 ft. 8 in. wide. The material is Lukens Steel Company Cromansil, an alloy of chromium, manganese and silica limit of 90,000 lb. and an elastic limit of 70,000 lb., possessing a high resistance to fatigue and shock. The completed structure weighs 6,070 lb. It is built into the lower chord member of the side trusses and forms the foundation for the nose structure of the car.

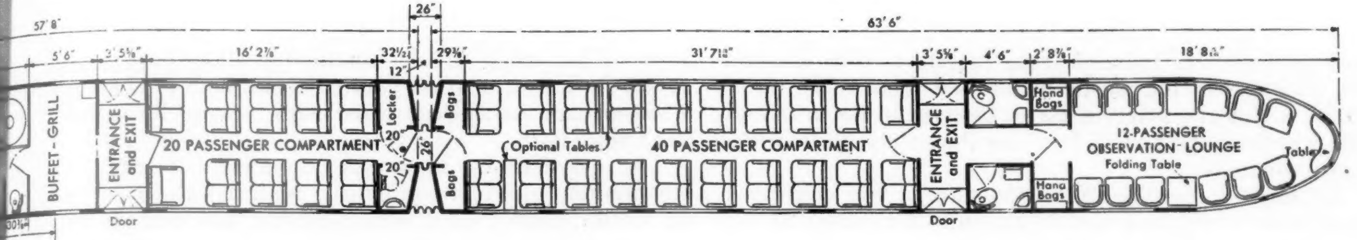
The nose construction consists of a deep, stiff member which extends diagonally outward and downward on the longitudinal center plane of the car from the roof

Principal Dimensions and Weights of the Burlington "Zephyr"

Length overall	197 ft. 1⅜ in.
Length from pilot to center power truck	13 ft. 9 in.
Length center of power truck to center of first trailer	60 ft. 8⅜ in.
Length from center of first trailer to center of second trailer	58 ft. 8 in.
Length from center of third trailer to center of fourth trailer	52 ft. 7 in.
Length from center of rear trailer to the end of train	11 ft. 5 in.
Height from rail over engine room	12 ft. 1³/₁₆ in.
Height from rail to roof	11 ft. 2⁷/₁₆ in.
Height from rail to floor (passenger compartments)	3 ft. 7 in.
Width overall	9 ft. 8½ in.
Wheelbase of trucks	8 ft. 0 in.
Wheel diameters:	
Power truck	36 in.
Trailer trucks	30 in.
Center plate height, loaded (trailer trucks)	25²⁵/₃₂ in.
Nominal journal sizes:	
Power truck	6 in. by 11 in.
First trailer truck	5½ in. by 10 in.
Second trailer truck	5 in. by 9 in.
Third trailer truck	4¼ in. by 8 in.
Light weight of train	195,000 lb.
Estimated weight distribution with normal load:	
Power truck	98,000 lb.
First trailer truck	67,000 lb.
Second trailer truck	45,000 lb.
Third trailer truck	30,000 lb.
Height center of gravity above rail	51 in.



Longitudinal dimensio[...]**of the**

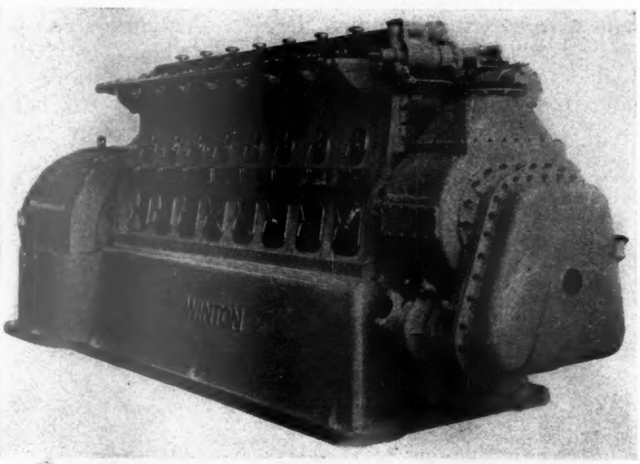


lington Zephyr

to the bumper portion of the engine bed. This is reinforced with a stiff horizontal arch at the belt rail and with a ¼-in. diaphragm which forms the bottom of the engine-cooling air-intake chamber above the cab windows.

Each articulation casting is tied into the frame structure at the end of the car by riveting to the center sills, to the end posts and to the lower chords and vertical members of the stainless-steel end trusses. No rivets other than these are used in the structure. The greater part of the bending moment due to the eccentric loading at the center pin is resisted by compression loading in the roof and the remainder by a bending stress in the center sills. The end posts are built-up of ⅛-in. stainless-steel plates and are 12 in. deep.

Unlike the stainless-steel cars previously built by the Budd company, the sheathing on the Burlington train is not all of the fluted type adopted to prevent the formation of shear lines and other weaves which would develop in the 0.020-in. sheets. Uncorrugated sheets of stainless steel are used around the curved surfaces at the front and rear ends of the train, on the curved roof at the rear end, and on the roof over the engine room.



The Winton eight-cylinder, two-cycle Diesel engine

Except on the front end, where plates are ⅛ in. thick, the material is 0.030 in. in thickness.

The deadlight panels are also finished with smooth surfaces. These panels are of Armorply, furnished by the U. S. Plywood Company, in which the outside surface of the plywood is covered with stainless steel and the inside with copper to prevent warping. These panels, some of which are of unusual length, are flexibly mounted in channels at the top and bottom, in which they are sealed with a plastic calking material. Below the window rail are mounted the customary fluted side sheets.

The space below the floor level is enclosed with light corrugated sheathing similar to the roofing. To prevent resonance from air-borne noises and direct concussions this sheathing is insulated with hair felt placed between two layers of 80-lb. Craft paper, the outer of which is cemented to the sheathing.

The walls and roofs of the cars are insulated throughout with Alfol, 128 lb. of which were required for the train.

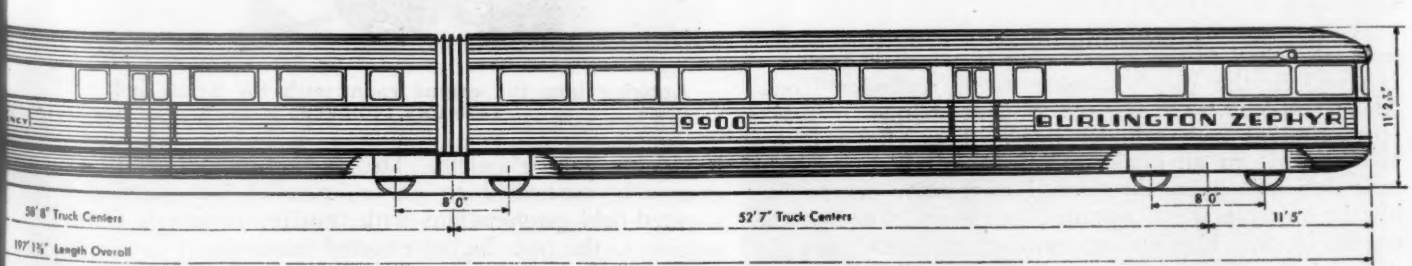
Interior Finish, Fixtures, Etc.

In the passenger compartments the side walls are finished with Masonite panels. The headlining is of Agasote. The walls of the baggage rooms are finished with galvanized sheets. The floors are laid with $5/16$-in. cork tiling cemented over the corrugated steel and cork filler in the recesses of the corrugations. In the mail compartment 1-in. maple flooring is laid over the cork. In the baggage compartment a layer of roofing paper is placed between the cork and the maple flooring.

All doors, when closed, form unbroken surfaces with the outside sheathing of the car. The side doors in the two baggage compartments and in the railway postoffice are of the sliding type. They are guided in top and bottom tracks so shaped as to move the door outwards into its flush position in the door opening when it is closed.

Vestibule passages between the car bodies are enclosed by diaphragms bolted to the ends of the cars. The foot plate is formed by an approximately semi-circular plate, its straight edge secured to the end of one car and the circular edge enclosed in a horizontal recess in the end of the opposite car within which it is free to slide when the cars pass over curved track. To provide continuity of the outer surfaces accordian type diaphragms are attached between the ends of adjoining cars.

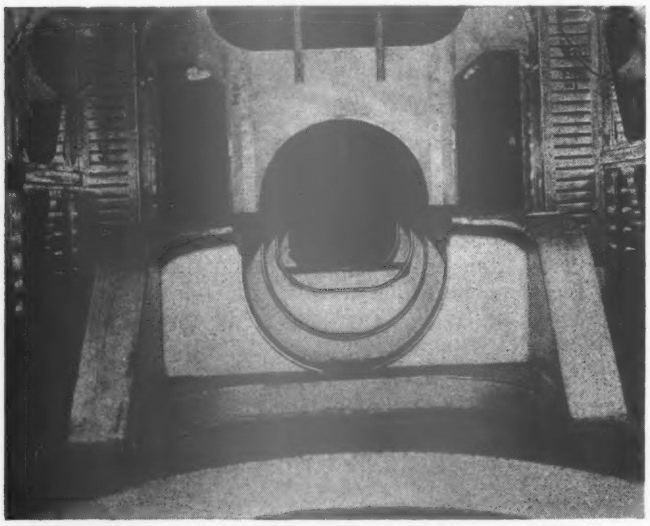
The safety window glass, supplied by the Pittsburgh Plate Glass Company, is 15 per cent lighter than the standard safety plate glass and much stronger. Generally speaking, the weight of safety glass is in the glass and the strength is in the plastic sheeting. Therefore, the thickness of the plate glass for this special lamin-



of the Burlington Zephyr

ated product was reduced from $^{7}/_{64}$ in. to 0.09 in., and the thickness of the plastic was raised from 0.025 in. to 0.050 in. for the safety glass to be used in the rear and side windows and to 0.075 in. for the safety glass in the front windows.

Because of the type of construction it was calculated that there would be a certain amount of weaving of the coach bodies which would crack the glass under usual



The engine bed, in place, looking toward the front

glazing methods. A system was developed of setting it in dum-dum putty, a non-hardening material, which allows play but still hermetically seals the windows to permit the air-conditioning system to operate efficiently. The window sash, furnished by the O. M. Edwards Company, are set flush with the outside surfaces of the train.

The Power Plant

The power plant for driving the train, including power auxiliaries, was designed by the Winton Engine Corporation, a subsidiary of the General Motors Corporation. Power for propulsion of the train originates in a Winton high-compression, two-cycle, 8-in. by 10-in. eight-in-line Diesel engine. Power for all auxiliaries, whether driven directly or indirectly, is taken from the engine in excess of its rated output of 600 hp. at 750 r.p.m.

Incorporated in this engine are several novel features of construction and design. For example, engine weight has been reduced to about 22 lb. per hp. by the Lukenweld process for welding steel plate to form a single-piece engine block, comprising the crankcase and cylinder block, to which a light oil pan is attached. Nine steel-backed, lead-bronze-faced main bearing liners, 6½ in. in diameter, are clamped by shimless bearing caps held in place with jack screws acting against the frame arch below the cylinder block.

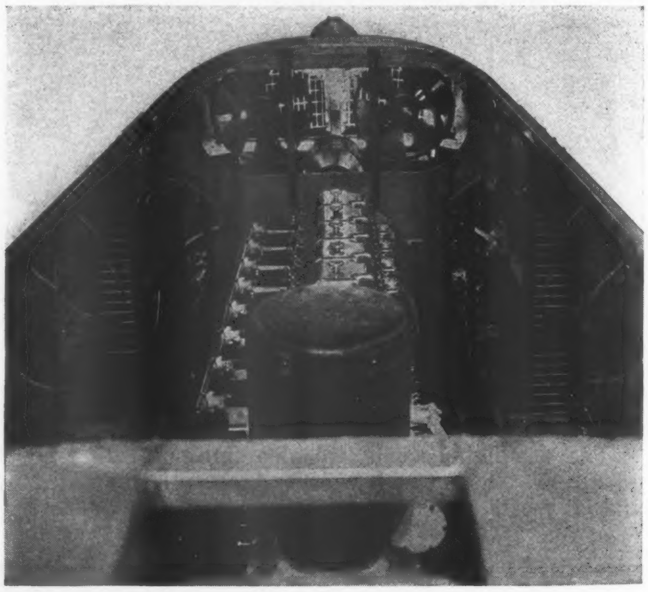
Water jacketed cylinder liners of heat-treated cast iron are bolted to the cylinder heads, which in turn are fastened in the usual manner to the cylinder block. About mid-length are cast twenty-four oblique air-intake ports circling each cylinder liner. Thus, the cylinder block forms an air-intake manifold in which pressure is maintained by a three-lobed twin-rotor scavenging blower or compressor, mounted on the front end of the engine block. This arrangement of air intake and the use of four 2¾-in. exhaust valves per cylinder insures scavenging of the cylinder at a minimum blower pressure. The heads of the aluminum alloy pistons are cooled by a stream of oil emitted from the top of special I-section connecting rods fitted with bearing liners having a 6-in. bore.

The possibilities in power economy, afforded by streamlining railroad equipment, required the remodeling of the conventional engine-cooling and exhaust systems to provide a smooth roof line. Two large engine-driven fans are mounted above the partition separating the engine room from the control cab. A grilled opening in the front of the train admits air to the fans via a duct formed by the cab ceiling and the car roof. The large volume of air brought into the engine room passes through the cooling radiators and thence outside through a central longitudinal slot in the roof.

The main generator is a single-bearing, differentially wound General Electric machine placed forward of the engine and directly connected through a flexible steel-disc coupling. A direct-connected exciter is used. A shaft extension is provided at the exciter end of the main generator to drive through V-belts a 25-kw. auxiliary generator mounted above the main generator. The opposite end of the auxiliary generator shaft is also extended for V-belt connections to the two fans which draw air into the engine room.

The two series-wound G. E. traction motors are mounted on the front truck of the leading car. They are self-ventilated by multiple fans mounted at the pinion ends of the armatures. Ventilating air is taken from the engine room through canvas ducts, and motor ventilation is aided by the slight positive air pressure—about 1 in. of water—in the engine room.

Motor control consists essentially of one master controller, electro-pneumatically operated motor contactors, and reversor, together with the necessary auxiliary magnetic contactors, switches, relays, etc. The control provides for operation from the front of the train only and for starting and stopping the engine, regulating



Looking into the engine room with the hatch and radiators removed

headlights, cab lights, etc. The traction motors are progressively connected in series, parallel and parallel-shunted-field combinations with transfer from one connection to the next higher effected manually.

The 25-kw. two-bearing 76-volt auxiliary generator is of the four-pole direct-current commutating-pole type.

The output of the generator is furnished to the air compressors, the air-conditioning equipment, motor for train heating boiler, battery charging, lights, control, buffet utensils, etc., at a constant voltage regardless of load or engine speed.

The storage battery is an Exide Ironclad 32-cell, 64-volt battery rated at 450 amp. hr. at the 10-hr. discharge rate, which is placed in a stainless-steel battery pit in the engine room. The weight of the battery is 3,260 lb. Ventilating scoops are used to increase air circulation in the battery box. The battery is used for engine cranking in addition to supplying power to the auxiliary circuits.

Two General Electric 25-cu. ft. air compressors, driven by 76-volt motors, furnish the necessary air for the train. These compressors are of standard design, but with aluminum frame parts to obtain a light-weight equipment.

The Trucks

The four trucks are all of conventional outside bearing type of construction. All have cast-steel frames and bolsters, furnished by the General Steel Castings Corporation. Their combined weight is 55,000 lb. without the motors and gears in the power truck. All journals are fitted with Timken roller bearings. The axles are hollow-bored to reduce weight.

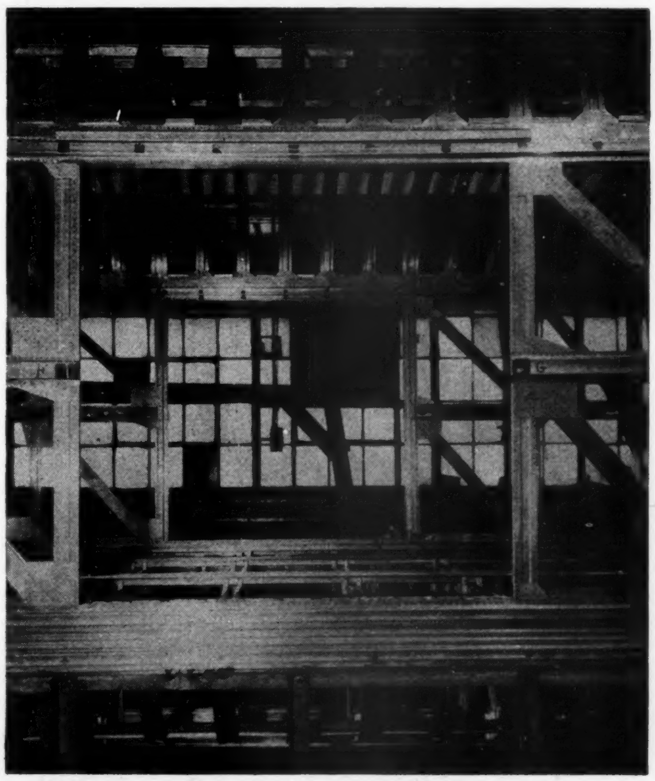
A 14-in. section of a structural member tested to destruction under compression—it withstood over 70,000 lb. per sq. in.

Of particular interest in the construction of the trucks is the extensive use of rubber insulation to prevent the transmission of sound and other high-frequency vibrations to the car bodies. There are inserts under the center plate, in both top and bottom equalizer spring seats and between the ends of the equalizers and journal boxes. Rubber liners in the pedestals are faced with Oilite metal plates, vulcanized on, which serve as bearing surfaces for the faces and flanges of the boxes. The bolster pads, which insulate the bolster from the truck frame, are also faced with Oilite metal. In addition to the pad under the center plate, rubber thimbles are provided around the king pin and the center-plate bolts, the latter also including washers. A further precaution against unnecessary noise is the provision of automotive brake lining wherever the members of the truck brake rigging are likely to rub. To dampen vibrations of lower frequency Holland helical-volute springs are used on the equalizers of all four trucks. These springs consist of the conventional helical outer coil with an inner volute spring in place of the inner helical coil. The center plate bearing, the bearing between the articulation castings and side bearings are all faced with Oilite.

Brakes

The train is fitted with Westinghouse SME-3 brake equipment, which has been modified specifically for high-speed articulated train units. This is a straight-air system with emergency feature and also has a brake pipe which permits standard automatic operation of the brakes in case it should be necessary or desirable to move this train in connection with steam-train equipment. There are three air lines on the train: (1) The emergency pipe through which the supply reservoirs for each vehicle are charged at all times under normal operation and the loss of pressure from which causes the control valves to effect an emergency application of the brakes; (2) the straight-air pipe, pressure variations in which cause the control valves to effect graduated service application and release, and (3) the brake pipe by means of which automatic operation of the brakes can be effected when the articulated train is moving in connection with steam-train equipment or when backing up and on which the conductor's valve in the rear car is placed.

The brake valve operates the brakes by controlling the pressure in the straight-air pipe. It is self-lapping, the degree of service application varying with the position of the handle, a feature by which great sensitivity is attained. The dead-man control is operated either pneumatically by a foot pedal or electro-pneumatically by a push-button on the brake-valve handle. The release of both of these automatically cuts off the power and causes an emergency application of the brakes. The brake valve also provides, electro-pneumatically, for an emergency application of the brakes should a failure of pressure in the straight-air pipe prevent a response to a movement of the brake valve to service application position within a predetermined time interval.



The carlines are closely spaced over the door openings

The end frame and articulation casting—The Shotwelds are clearly visible

In order to effect the high rates of retardation required to keep stopping distances from speeds of 100 or more miles per hour within present limits, the brake system is designed for a 200-per cent braking ratio at 100 lb. cylinder pressure. Because of the increasing coefficient of brake-shoe friction as the speed is reduced, the brake-cylinder pressure is controlled automatically as the train slows down by a retardation controller, a pendulum inertia device by which brake-cylinder pressure is reduced at a rate sufficient to maintain a constant predetermined retardation rate. The retardation controller is wired in the battery circuit to solenoids on the control valves and through these the control of brake-cylinder pressure is effected.

Aluminum has been used extensively in the air-brake equipment in the interest of weight reduction. This includes the control-valves and brake cylinders, etc. The supply reservoirs are of light-gage stainless steel.

The Heating System

The train is equipped with steam heat throughout. Each passenger compartment also has its own mechanical air-conditioning system. These are interlocked with the heating system so that the force-ventilation feature of the air-conditioning equipment is available both winter and summer.

Steam for heating is provided by an oil-fired Peter Smith boiler with an evaporative capacity of 500 lb. per hour at a pressure of 85 lb., furnished by the Vapor Car Heating Company. This boiler is located at the rear end of the baggage room in the second car. Its operation is completely automatic and, in order to reduce weight, the condensate from the radiators is returned to the 50-gal. feedwater storage tank. Storage is provided for 75 gal. of fuel oil.

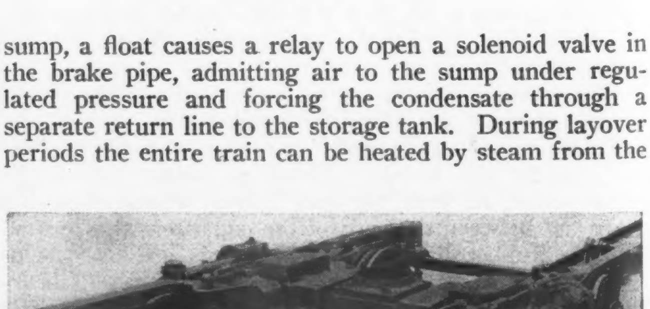
The operation of the boiler is subject to three controls: (1) A water-level control; (2) a low-water control, and (3) a burner load control. The water-level and low-water controls are of the electrode, commonly called spark-plug, type. Current at 110 volts, furnished by a small motor-generator set, passes from the electrodes to their grounded metal container through the water. If the water drops below the end of the longest electrode, the failure of the current acts to close the oil-supply valve and stop the burner motor. A variation of the water between the ends of the intermediate and short electrodes serves to cut the feed pump in or out.

If pressure in the boiler builds up beyond a predetermined point owing to a load insufficient to utilize all of the steam being produced, a pressure switch operates automatically to reduce the flow of oil to the burner and the speed of the burner motor, thus maintaining a flame which is little more than a pilot light until such time as the reduction in pressure restores the flow of oil and the speed of the motor fan to their full-load amount.

Heat is supplied to the passenger compartments from two sources. A fin-tube coil in the evaporator unit of the air-conditioning system in each compartment supplies heat to the fresh and recirculated air passing through the units to the compartments. Steam is also supplied to a copper fin-pipe along the truss plank near the floor on each side of the compartment. The admission of steam to both radiators is controlled by motorized valves which are actuated by independent thermostats. A thermostat for the control of the air-conditioner radiators is located on a deadlight panel near the center of each compartment about 5 ft. above the floor. The thermostat for the side-wall radiators is placed near the floor and serves to bring these radiators into action automatically when the heat distribution from the air-conditioning unit is not sufficient to maintain a predetermined temperature at the floor.

A unique scheme has been developed for returning condensate from the radiators of the front and rear cars to the feedwater storage tank on the second car. Water from the radiator traps drains into small sumps, one on each of the two cars. As the water level rises in the sump, a float causes a relay to open a solenoid valve in the brake pipe, admitting air to the sump under regulated pressure and forcing the condensate through a separate return line to the storage tank. During layover periods the entire train can be heated by steam from the

The power truck



One of the trailer trucks

terminal supply. The heating and thermostatic controls are the product of the Vapor Car Heating Company.

Air Conditioning

Each of the three passenger compartments is served by a complete York mechanical air-conditioning unit of 1½ tons nominal capacity. The compressors as well as the condenser and evaporator units are all located within the underbody below the floors of the coaches. The evaporators deliver air through the grilles in the bulkheads over

Framing of the rear car—The Alfol insulation is partially applied

the center doors into the compartments. Recirculated air leaves the compartments through filter-protected openings in the floor over the evaporator units.

The motors for operating the compressors and the evaporator-unit fans were manufactured by the General Electric Company. A 7½-hp. a.c.-d.c. motor operates the two compressors and the condenser fans on the third car and a 3-hp. d.c. motor drives the compressor unit and the condenser fan on the second car. For standby service when the main power plant is not in operation a tap from a 220-volt, 60-cycle terminal supply can be plugged in to operate the a.c. motor on the rear coach. This drives the two units on this coach and the d.c. motor becomes a generator which supplies current for reduced-capacity operation of the unit on the second car. The d.c. motors operate on 76-volt current from the head-end supply. The compressor motors operate at 1,750 r.p.m. Two ¼-hp. and one ⅓-hp. motors drive the evaporator fans. The complete equipment, including the motors and controls, has a total weight of about 2,400 lb., and with refrigeration lines, water lines, electric cables, etc., included, does not exceed 3,000 lb.

Copper pipe with sweated fittings has been used throughout the train for water, steam and air. Its use has effected a piping weight reduction estimated at 60 per cent. It is scale-proof and once installed possesses a high degree of permanence. Because of the difficulty of access for replacement of some of the piping, this factor was of considerable importance.

Interior Fittings

In the smoking and passenger compartments the lighting is indirect, the lights being concealed within longitudinal ducts below the ceiling along each side of the car. The sides of these ducts toward the sides of the car are open and the light reflected from the curved inner surfaces of each duct and against the curve of the ceiling and the side of the car is diffused in a wide angle which reaches completely across the car at the reading height. The illumination on each side of the car is thus received from the lights in both conduits. The exterior of the conduit is blended into the surface of the ceiling by smooth flowing curves. The lighting is designed to produce an intensity of eight foot-candles at reading height. The lounge is lighted directly through diffusing glass which covers the underside of long ducts placed along the walls just above the windows.

The seats in the smoking and passenger compartments are built on light-weight aluminum frames. Those in the smoking compartment are upholstered in leather and those in the main passenger compartment, in Chase Velmo low-pile mohair. The backs are adjustable from the normal upright to a semi-reclining position. They are built with a clear space 18 in. high underneath for the stowing of hand baggage. All passenger compartments of the train have radio reception.

Lights

The front headlight is a 14-in., 250-watt, Golden Glow unit made by the Electric Service Supplies Company. The back-up light is a 9-in., 40-watt unit made by the same manufacturer. The marker and classification lights are Pyle-National airplane-wing lights in built-in housings.

All lights inside the car and also all auxiliary apparatus are controlled through Westinghouse Nofuze load centers. Arrow, Hart & Hegeman heater switches provide for connecting inside lights all in multiple, for using only alternate lights and for dimming the lights by connecting the two groups in series.

Photo by Wendell MacRae, New York

Looking toward the rear of the main passenger compartment from the smoking room—The air-conditioner grille is over the door in the bulkhead

Locomotives Inadequately Depreciated

Over half the steam locomotives are 20 or more years old —Depreciation rates indicate projected lives varying by types from 28 to over 50 years

In personal letters to the presidents of the Class I railways, Co-ordinator Eastman, on April 24, enclosed a series of statements relating to steam locomotives, based in part on the returns to a questionnaire addressed to them on November 8, including a report by the Section of Car Pooling in which is summarized the first section of its study of the returns, dealing with description, condition, potential capacity, and programs for repair and retirement. The second section, devoted to a study of repair costs with relation to the age and size of locomotives, will follow in the near future. These studies, Mr. Eastman said, are believed to constitute the most complete summarization of steam locomotive data ever undertaken.

An accompanying memorandum by O. C. Castle, director of the Section of Car Pooling, said that from the facts it is apparent that there is ample power if adequately maintained to protect any probable increase in traffic in the near future but that this does not imply that it may not be economical or desirable to purchase new power. Calculated on a tractive power basis, the remaining mileage for all locomotives is placed at the equivalent of 34.8 per cent of the total estimated potential, and the difference between such ratio and 50 per cent, the accepted normal, is said to represent the extent of deferred maintenance. In commenting on the statements Mr. Eastman said in part:

Mr. Eastman's Comment

The value of the information developed obviously depends upon the use which is made of it. Means for applying the general data to the situation on an individual railroad, as more clearly presenting essential facts, will suggest themselves to executives.

Ages; Ledger Values, Accrued Depreciation and Projected Life of Locomotives of Class I Railways, by Types

Whyte symbol	Number	Per cent service group	Age, weighted	Ledger values	Accrued depreciation	Annual rate depreciation	Years life at rate depreciated
				SWITCH			
0-6-0	5,797	65.8	23.1	$16,799	$9,504	2.45	41
0-8-0	2,821	32.1	15.2	33,090	12,001	2.39	42
0-4-0	142	1.6	24.4	12,358	8,287	2.75	36
Others*	44	0.5	...	......	.....	...	..
Total	8,803	100.0					
				ROAD			
2-8-0	11,266	26.4	25.9	$20,543	$12,772	2.40	42
2-8-2	9,830	23.1	15.9	43,428	18,441	2.67	37
4-6-2	5,528	13.0	18.8	34,493	15,960	2.46	41
4-6-0	4,451	10.4	28.6	17,176	10,040	2.05	49
2-10-2	2,054	4.8	14.5	62,808	29,711	3.26	31
4-8-2	1,809	4.2	8.9	71,110	20,052	3.17	32
2-6-0	1,171	2.8	29.6	16,340	10,291	2.13	47
4-4-2	862	2.2	26.7	20,898	13,800	2.47	40
2-10-0	843	2.0	12.0	61,338	26,202	3.56	28
2-6-2	776	1.8	27.5	21,031	14,185	2.45	41
4-4-0	750	1.7	34.2	13,104	8,350	1.86	54
2-6-6-2	649	1.5	17.4	53,212	24,875	2.68	37
2-8-8-2	525	1.2	12.6	82,375	26,596	2.56	39
4-8-0	409	0.9	29.9	20,418	12,531	2.05	49
2-8-4	293	0.7	5.7	93,577	19,621	3.68	27
4-6-4	285	0.7	4.3	82,923	10,942	3.07	33
4-8-4	282	0.7	3.6	106,620	12,713	3.31	30
2-8-8-0	226	0.5	14.7	70,560	35,842	3.46	29
2-10-4	186	0.4	4.4	100,831	15,861	3.57	28
All others†	427	1.0	...	.....	.....	...	..
Total	42,622	100.0					
Total road and switch	51,425						

* Includes forty-two 0-10-0, one 0-12-0 and one 0-16-0.
† Includes 21 types, of which 219 locomotives are of 9 articulated types.

The calculations in the attached statement were produced with the aid of tabulating machines. The punched cards used in the process are available for use in further general studies, or may be availed of by individual railroads desiring to analyze their reports on Form CP-2 and Form CP-3. My Section of Car Pooling will undertake to supervise such individual studies, providing the railroads desiring them will assume the cost of the tabulation and the extra clerical work involved. The cost of such a study should be nominal.

Respecting the results of the general study, it seems in order to comment upon a few of the interesting and important items, and to suggest some of the features which should prove of practical value at this time.

In submitting the questionnaire form, I requested those addressed to indicate their preferences or to give expression to their personal views on several subjects directly related to locomotive efficiency and operating economy. The replies are summarized. Unfortunately the value of this summary is lessened by the failure of many of those addressed to reply to the questions.

Steam Locomotives by Age Groups and Retirement Program, Class I Railways

Grouped by age years	Number owned Oct. 1, 1933	Per cent of total	Number to be retired by Dec. 31, 1938	Per cent of age group
0- 3	763	1.5	....	...
4- 6	1,932	3.8	....	...
7-10	6,132	11.9	1	...
11-15	6,948	13.5	44	0.6
16-20	8,052	15.7	471	5.8
21-25	9,740	18.9	1,408	14.5
26-30	11,853	23.0	2,986	25.2
31-35	4,441	8.6	1,499	33.8
36-40	606	1.2	294	48.5
41-45	712	1.4	380	53.4
46-50	180	0.4	83	46.1
51 and over....	66	0.1	46	69.7
Total	51,425	100.0	7,212	14.0

One of these questions was with respect to the most reliable unit for comparing locomotive repair costs. The statistical data on this feature of the study will appear in section two of the report, and the significance of the replies will be discussed in that section.

Depreciation Anomalies

Another question dealt with the extent to which recent studies have been made for the purpose of determining the relative economic value of certain types of locomotives. Only six of the 146 railroads addressed advised that such studies have been made within the past five years. Possibly this apparent lack of interest in a factor of such vital moment in the operation of a railroad, may throw some light upon the startling variations which appear in the depreciation calculations.

There may be good reasons for such a wide spread in the life expectancy; for example, as between the 2-10-0 type, with 28 years, and the 4-4-0 type with 54. There may be a satisfactory explanation for the fact that Southern railroads base their calculations upon a life of 98 years for the same type of locomotive which is expected to reach its limit at 47 and 48 years in the Eastern and Western districts. Such reasons and explanations are not likely to be developed, however, without a more scientific study of locomotive efficiency and obsolescence than has heretofore been devoted to the subject, if we are to rely upon the replies so far submitted. Probably one answer is that the reporting railroads do not expect to secure any such length of service as the calculations show, and that the exaggerations are due largely to the fact that depreciation charges in these cases are inadequate.

As I have previously pointed out, there is little temporary and no permanent advantage in understating depreciation, and to the extent that the practice is continued, it affects the solvency of a concern and presents a misleading picture to the security holders and the public. It is encouraging that a large proportion of the roads replying have indicated their desire to adjust these undercharges by writing off the deficiency as a charge to Profit and Loss. Such action should have a beneficial effect by expediting the retirement of those units which, through obsolescence or excessive maintenance costs, cannot be economically retained in service.

In the light of the progress made in recent years in locomotive design and in the use of mechanical power in transportation, the fact that more than half of the steam locomotives now in service are over twenty years old is worthy of serious consideration.

The two items of operating expense which are most directly affected by the age and design of motive power, locomotive repairs and fuel, together constitute a substantial proportion of the total cost of operation. I am sure that you appreciate the opportunity for economies which lies in this field of research and hope that you may find the results of our locomotive studies helpful in the analysis of your own situation.

Summary of the Study

Mr. Castle's summary follows:

The total number of steam locomotives owned by Class I Railroads, as reflected by their reports, is 51,425, averaging 20.7 years of age.

The oldest unit reported was built in 1865. The owner of this locomotive schedules it for class repairs in 1938 when it will be 73 years old.

More than 53 per cent of all locomotives, or 27,598, are 21 years or more of age. Of this number 6,696, or about one-fourth, are scheduled for retirement by the end of 1938.

On the basis of wheel arrangement there are forty-six types of locomotives, of which forty are road and six are switch types.

Seven types include 84.7 per cent of all road locomotives, and 97.9 per cent of the switch units fall under two types.

The ledger value averaged $33,402 per unit, and varied by types from $2,806 to $172,031.

The average cost per tractive-power pound is seventy cents, the variation in this cost as between districts being but 3.3 per cent.

The accrued depreciation averaged $15,136 per locomotive, equivalent to an annual rate of 2.19 per cent. Applying this rate to the average ledger value, we find the projected life of existing locomotives averages 46 years. There are wide variations in the life expectancy, indicated by the depreciation rate, as between roads and as between types. The most hardy type appears to be an 0-16-0, with a projected life of 1,111 years. Other unusual cases are 286, 167, and 100 years respectively.

During the year ending September 30, 1933, there were 10,120 steam locomotives which made no mileage. These units constitute 19.7 per cent of the total.

In a general way, the variations in the ratio of idle to total locomotives by types give some indication of degrees of absolescence or surplus. For example, the types showing ratios of idle units substantially above the average were: 4-4-0 (American) 42.9 per cent; 2-6-6-2 (Articulated) 33.7 per cent; 2-6-2 (Prairie) 33.1 per cent; 2-6-0 (Mogul) 30.6 per cent; 4-4-2 (Atlantic) 30 per cent.

Included in the idle locomotives were 2,110 units held for sale or scrap. The time these locomotives were so held averages 27.2 months. The district averages are: Eastern 22.9, Southern 28, Western 30.4. One railroad with an ownership of about 200 locomotives reported 35 per cent of its ownership stored an average of 51.6 months. The trackage occupied by these 64 locomotives

Estimated Maximum Locomotive Mileage Obtainable for 61-Day Peak

		Locomotives in servicc August and September, 1933						Miles for 61-day peak from locomotives drawn from storage			Miles for 61-day peak from locomotives repaired			Total miles obtainable for 61 days from all locomotives		
					Max. miles for 61-day peak										
Whyte symbol	Number	Number active	Avg. miles per day	Avg. miles per loco. day	Avg. miles per day	Avg.miles per loco. day	No. stored serv-iceable	Avg. miles per day	Avg. miles per loco. day	No. locos. that would be repaired	Avg. miles per day	Avg. miles per loco. day	Total locos. (excl. sale or scrap)	Avg. miles per day	Avg. miles per loco. day
							Switch								
0-6-0	5,797	3,978	217,113	54.6	316,270	79.5	577	45,946	79.6	850	57,399	67.5	5,405	419,615	77.6
0-8-0	2,821	2,242	162,598	72.5	206,581	92.1	159	14,973	94.2	403	42,207	104.7	2,804	263,720	94.0
Others	186	140	7,543	53.9	12,150	86.8	17	1,853	109.0	22	1,483	67.4	179	15,526	86.7
Total	8,803	6,360	387,253	60.9	535,001	84.1	753	62,772	83.4	1,275	101,089	79.3	8,388	698,861	83.3
							Road								
2-8-0	11,266	6,681	411,326	61.6	651,658	97.5	1,215	118,283	97.4	2,818	194,712	69.1	10,714	964,653	90.0
2-8-2	9,830	6,345	572,174	90.2	806,036	127.0	921	113,935	123.7	2,490	257,401	103.4	9,756	1,177,372	120.7
4-6-2	5,528	3,866	576,808	149.2	744,059	192.5	543	88,448	162.9	1,052	180,345	171.4	5,461	1,012,852	185.5
4-6-0	4,451	2,543	179,419	70.6	307,180	120.8	620	66,719	107.6	820	74,782	91.2	3,983	448,681	112.6
2-10-2	2,054	1,251	103,967	83.1	153,248	122.5	290	32,280	111.3	511	53,587	104.9	2,052	239,115	116.5
4-8-2	1,809	1,343	217,721	162.1	244,020	181.7	103	13,631	132.3	363	61,749	170.1	1,809	319,400	176.6
2-6-0	1,171	636	33,066	52.0	56,263	88.9	91	7,124	78.3	281	15,421	54.9	1,008	78,808	78.2
4-4-2	862	440	47,154	107.2	69,700	158.4	122	20,929	171.5	231	21,924	94.9	793	112,544	141.9
2-10-0	843	487	40,175	82.5	46,800	96.1	104	5,857	56.3	211	24,223	114.8	802	76,881	95.9
2-6-2	776	409	24,966	61.0	33,612	82.2	144	11,748	81.6	147	11,019	75.0	700	56,379	80.5
4-4-0	750	330	18,799	57.0	40,525	122.8	114	13,114	115.0	137	8,859	64.7	581	62,497	107.6
2-6-6-2	649	309	21,288	68.9	39,361	127.4	144	17,783	123.5	111	6,155	55.5	564	63,433	102.5
2-8-8-2	525	410	31,388	76.5	45,883	111.9	31	3,073	99.1	84	6,769	80.6	525	55,724	106.1
Others	2,108	1,533	226,674	147.9	267,293	174.4	198	20,828	105.2	348	60,469	173.8	2,079	348,457	167.6
Total	42,622	26,583	2,504,917	94.2	3,505,638	131.9	4,640	533,752	115.0	9,604	977,415	101.8	40,827	5,016,807	122.9
							Switch and Road								
Total	51,425	32,943	2,892,170	87.8	4,040,639	122.7	5,393	596,524	110.6	10,879	1,078,504	99.1	49,215	5,715,668	116.1

set aside for more than four years is located in a large industrial center.

Using the actual locomotive mileage made during August and September, 1933, as a basis, the railroads estimate that with an adequate preliminary repair program, they could, under conditions of peak demand, increase the total locomotive miles per day with the engines in service 39.7 per cent, and obtain from them as a maximum 122.7 miles per locomotive-day. From 5,393 locomotives to be withdrawn from storage, additional mileage equal to 20.6 per cent of the August-September actual could be secured. From the shop out-turn, the estimated mileage equals an additional 37.3 per cent, making all told, a possible increase in total locomotive-miles per day of 97.6 per cent.

The average miles per locomotive-day under the assumed conditions is, for those in service, 122.7; withdrawn from storage, 110.6; and all locomotives, 116.1.

The actual freight and passenger locomotive miles made during the peak month of October, 1929, was 3,495,188 per day. The carriers now estimate they could, under the assumed conditions, produce 5,016,807 locomotive-miles per day with road power. That is to say, they now have power sufficient to make, for a 60-day period, 43.5 per cent more locomotive-miles per day than during the peak month, October, 1929.

From these facts it is apparent that there is ample power if adequately maintained to protect any probable increase in traffic in the near future. This does not imply that it may not be economical or desirable to purchase new power. There are other factors to be reckoned with in determining this question. It is hoped that our study of Form CP-3, which will shortly be released, will have data which may be helpful in aiding the railroads to determine the economic life of motive power from the standpoint of cost of repairs.

The estimated mileage which can be secured from power when new, or between shoppings for general repairs, averages 86,380 per locomotive. By districts the averages are, Eastern 68,158; Southern 86,835; Western 105,423.

Analysis of the reports develops that on October 1, 1933, the mileage remaining in locomotives was 33.7 per cent of the estimated potential. The district averages were, Eastern 37.9 per cent; Southern 32.1 per cent; Western 31.5 per cent. Calculated on a tractive power basis, the remaining mileage for all locomotives is equivalent to 34.8 per cent of the total estimated potential. The difference between these ratios and 50 per cent, the accepted normal, represents the extent of deferred maintenance.

Diesel Locomotives

(*Continued from page 145*)

engine except on one basis. That is, that a four-cycle engine with its positive displacement of exhaust gases by the piston and its rather conventional valve mechanism may be designed almost to formula, while this is not true of the two-cycle type. In contrast, the designing of a two-cycle engine, particularly with reference to ports, shape of combustion space, i.e., the top of the piston and under side of cylinder heads, and the fuel injection mechanism, must be developed experimentally and such development obviously requires a considerable period of time, together with proper facilities and a background of experience with such engines. However, when these details have been worked out so that good combustion results and so that an engine performs to the satisfaction of a reputable builder, the operator of the engine is relieved of the responsibility for maintaining the condition and adjustment of a mechanism which does not exist on the two-cycle engine, but which is vital to the proper functioning of a four-cycle engine.

There was a time when the four-cycle engine offered the advantage of fuel consumptions from 25 to 30 per cent lower than that on the two-cycle. This condition no longer exists, as we now find many two-cycle engines with fuel consumptions below those on some four-cycle engines. However, fuel consumption is but one item in the overall cost of operation, and operating records show that this overall cost is lower for two-cycle engines.

Mr. Sawyer emphasized that all Diesels applied to locomotive service have been of the four-cycle type and that is true, at least in this country. He might have added that these engines were a product of a very few companies. Of the more than 50 builders of Diesel engines in this country only a few have felt justified up to this time in entering upon the development work required for a market, the demands of which, until very recent years, seemed uncertain and it just happens that those builders who did see fit to tackle the development were manufacturers of four-cycle engines.

The argument between advocates of two-cycle and four-cycle engines will undoubtedly continue for years to come. As evidence that this is true, within the past year, an important builder of Diesel engines in this country, who has never offered anything but four-cycle engines, brought out a line of two-cycle engines; and another large builder who has offered two-cycle Diesels exclusively, brought out a line of four-cycle.

Comments by C. E. Beck*

In 1930 Busch-Sulzer Bros. appropriated a quarter of a million dollars for railroad Diesel engine research and development work which has proceeded uninterruptedly for four years. It was necessary to approach the problem from two angles. First, we had to consider carefully what had already been developed and, second, what we were best qualified to develop. Switching Diesel locomotives up to 800 or 900 hp. have been introduced successfully by several American builders having experience exclusively in the building of engines operating on the four-stroke cycle. After due deliberation, we decided not to enter this field in order to avoid the expense of parallel development and the commercial menace of excessive competition.

Our engineering experience embraced the building of both two- and four-cycle engines, our first two-cycle engine having been built for the U. S. Navy submarine service more than 20 years ago and at the close of the World War we were building units up to 2,500 hp. for the service.

Being fully cognizant, therefore, of the relative merits of the two- and four-stroke cycle engine, we accordingly attacked the problem of sufficient reduction in size and weight of the higher power two-cycle machine to meet the requirements of heavy switching, transfer, main line passenger and freight locomotives from 1,600 hp. to 3,500 hp. capacity. These sizes were selected with anticipation of lighter passenger trains with somewhat higher speeds. It is expected that 85 per cent of all future locomotives will not exceed 3,500 hp.

With the horsepower limitations determined, we attempted to meet the following requirements: 1. Weight not to exceed 25 lb. per hp. 2. Rotative speeds around 550 to 600 r.p.m. 3. Reliability—assured by extreme simplicity, use of the best materials known, a minimum number of moving parts and elimination of the personal equation of the operator to a maximum degree.

An eight-cylinder Vee type, two-cycle engine of 1,600 hp. has been complete and is now under test.

* Sales Engineer, Busch-Sulzer Bros.-Diesel Engine Company.

Progressive Repairing of Box Cars*

By A. H. Faerber†

Description of system used by New York Central at East Buffalo car shop

THERE are many problems to be considered in connection with establishing a progressive system of freight-car repairs. Most prominent among these is the layout of the erecting shop in relation to yard tracks, fabricating departments—such as wood mill, machine shop, blacksmith shop, etc. Fortunately, the New York Central car shop at East Buffalo, N. Y., which is approximately 1,000 ft. long and 380 ft. wide, is well located in this respect, being connected with yard tracks at both ends. This makes possible the entry of cars at one end of the shop, progressing through different positions inside of shop and emerging at other end practically finished. All departments mentioned are in close proximity; in fact, they are integral parts of the shop.

Material distribution is another matter of vital importance. It is absolutely necessary that material required in the various positions be available for immediate use of workmen, as any delay in this respect would retard the movement of cars and cause confusion. Co-operation by the stores department is an important factor in the achievement of desired results, and I am happy to state that this co-operation is whole-heartedly afforded.

The supplying of material direct to cars from shop storage tracks is handled by material men. Each position has its individual material man or men, the number of men being determined by the class of material used and amount of work performed in that position.

Many difficult problems had to be solved in establishing this progressive system of house-car repairs, among which were the following: Laying out positions in proper rotation, building-up the proper force in each position to obtain the best results and desired production, timing each position to operate in harmony and prevent overlapping with the next position and elimination of lost time.

At the East Buffalo shop progressive operations are confined to three bays, each bay consisting of three tracks, only two of which are used for actual car-repair work. Each track has a capacity of 18 cars. The center track in each bay is used partly for material storage, the balance of about 80 ft. being used for repairs to side doors. All bays, with the exception of middle or old shop, are serviced by overhead cranes and necessary outlets for compressed air are located at convenient points along each track. The center bay in the south end of the shop is used for fabricating and straightening metal parts and contains the necessary machinery to do this work.

The number of tracks in use at any one time depends on the desired shop output. The system was planned with the objective of eight cars per day from each track, or a maximum daily shop production of 48 cars. The class of car and extent of repairs required is the measuring stick to govern the number of men or man-hours required in each position to complete the work so that cars can be moved to the next position at the allotted time without delay to line movement.

The same system has been employed with success on steel-underframe wood-superstructure box cars, although this class of equipment presents a more difficult problem than the all-steel box cars now being handled.

Inspection and Stripping

Due to limited storage space for crippled cars the system had to be built up with the fact in mind that there could be no absolute classification. All cars, with the exception of badly damaged or wrecked cars, are run through progressive tracks as received. Damaged cars are cut out and placed on special tracks and repairs brought up to a point where they can be placed on progressive line without retarding the movement of other cars. Men employed on preparatory work on wrecked cars are available to take the places of absentees on the progressive line.

Two assigned tracks adjacent to the stripping tracks, which are open at both ends and have a total capacity of 80, 40-ft. cars, are used for the reception of incoming cars. At this point all refuse is removed from inside of cars by laborers. Straw, paper and other combustibles are disposed of in a large incinerator, while non-combustibles, such as broken tile, plaster board, etc., are loaded in company-service gondola cars and eventually disposed of at the cleaning tracks. After the interior of the car has been cleaned out, an inspection is made of the entire car and a work card is applied covering all work to be done on the stripping tracks. A statistical report is also made up at this time showing complete physical record of each car. The principal items embodied are type and style of coupler, coupler pocket and draft gear, style of trucks, date and point of last reweighing, date built new, and other data required to supply desired information for shop and general office. After this inspection has been made the cars are ready to be placed on the stripping tracks by the shop engine. These tracks have a capacity of 57 cars.

Approximately 48 to 60 cars are stripped per day, every effort being made to have at all times 100 or more cars stripped ahead of shop requirements in order that operations may be carried on in the event of stripping, which is done in the open, being slowed down by inclement weather. Mechanics on stripping tracks work in gangs of two or four men. A rotating system of assigning work is in force at this point; the first gang to finish a car takes up the next car on the track to be stripped. Tools for the immediate use of stripping gangs are kept in the toolroom at stripping track with an attendant in charge who delivers all broken or worn-out tools to various shop departments for repairs or renewals. He is also required to lubricate all pneumatic tools in use several times daily during regular working hours. This lubrication has provided more efficient service, lower maintenance cost per tool, reduction of lost time and assurance of safer working conditions for employees.

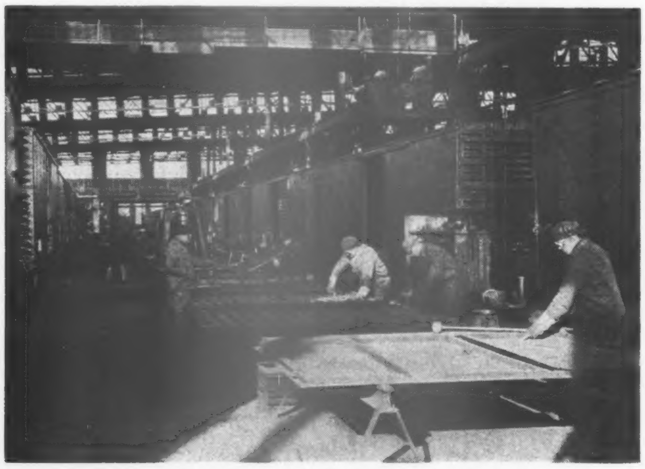
* Paper presented before the meeting of the Eastern Car Foreman's Association on January 26.

† Car shop superintendent, East Buffalo, N. Y.

All serviceable metal parts removed from the car during stripping operations are placed in racks and delivered by power trucks to fabricating departments for straightening or other repairs. Scrap wood removed from the cars is placed in suitable size piles and when accumulation warrants is loaded into gondola cars assigned to scrap wood service. This loading is done by an industrial crane equipped with wire rope slings. Periodically it is necessary to give the stripping tracks a general clean-up of all small refuse, wood chips, etc. This is raked into piles and is loaded into cars by an industrial crane equipped with clam-shell bucket. Scrap metal, such as rivet heads, small scrap castings, etc., is separated from dirt and chips and loaded with a magnet.

Sandblasting and Prime Painting

Stripped cars are next moved to sandblast and prime coat painting location, which consists of two tracks built on an incline, thus permitting cars to be moved into sandblast frame by gravity. The sandblasting frame is 56 ft. in length with permanent side scaffolds and movable end scaffold planks.



Preliminary work on side doors is done in space adjoining position No. 3

When sandblasting has been completed, cars are advanced to another position on the same track where car cement or other matter that sand will not cut is removed with wire brushes and scrapers.

Cars are then given a thorough interior and exterior cleaning with compressed air to remove all loose sand and scale and then advanced to a position where the complete underframe is sprayed with one coat of car cement.

Interior of side sheets and steel ends are also sprayed at the bottom with the same material to approximately 18 in. from top of underframe. Exterior and interior of roof and exterior of body are sprayed with one coat of approved metal protector or paint. New steel side-door panels and new steel side sheets are sandblasted and primed before application to car. This assures the removal of mill scale, likewise all oil, grease, etc., accumulated during process of fabrication.

Men employed at sandblasting are protected by modern approved sandblast helmets which provide pure washed air. Painters, helpers and laborers employed in sandblast territory are required to wear dust respirators and goggles for protection.

Work Done in First Three Positions

After completion of sandblasting and prime painting, cars are ready to be placed on progressive line for building-up operations, starting at south end of shop.

In position No. 1 the cars are again inspected and work cards applied covering all steel work, wood framing, application of flooring, inside lining, grain strips, roof repairs and running boards. Journal-box packing is removed and loaded into drums for delivery to reclamation plant. Additional stripping, such as signboard and brake-step board brackets, loose rivets, studs, etc., which cannot consistently be removed on stripping tracks with pneumatic rivet cutters, is done at this point by acetylene burners in order to eliminate the possibility of elongated holes or other damage to steel sheets or ends. Side doors are removed from cars and delivered to door work rack for repairs necessary.

Position No. 2 is the first one inside of the shop, the cars being pulled into the shop from position No. 1 by a long cable, snatch block and overhead crane. Cars are brought into the shop in units of two on each track and are advanced in groups of two. In this position all necessary straightening is done. New or repaired metal parts—except buffer blocks and center plates—are slush painted, fitted, applied, bolted with slotted fitting bolts, holes drilled and reamed preparatory to driving rivets. Roof sheets—except complete roof—and new or repaired doors are applied. Air hose, angle cocks, brake-pipe nipples and retaining valves are removed. An overhead crane serves in this bay.

Cars are now ready to be advanced to position No. 3, but before taking up the work done in this position would call attention to the door position, which is located on the intervening track parallel to position No. 2. All doors removed from cars in this bay are brought to this point for repairs. This work is done on a table approximately 70 ft. long composed of old rails raised 25 in. from the floor on metal standards or legs. Progressive work is in force at this table. Starting at the south end where doors are stripped and straightening done, they are moved along the table to the next position for application of new or repaired parts. After they have been fitted and bolted the door is again advanced on the table for drilling and reaming.

The door is next placed on an A-shaped steel riveting frame where all rivets are driven without the necessity of again moving the door. After joints have been laid up, the door is placed on storage horses where any necessary welding is done. From this point doors are taken by overhead crane and applied.

Returning to the cars on line: In position No. 3 all body rivets, except those of buffer blocks and center plates, are now driven.

Work on Trucks, Draft Gear and Air Brakes

Repairs to trucks, couplers, draft gears and air brakes, buffer castings and center plates are performed in posi-

Riveting of doors is done on an A-shaped frame

tion No. 4. As cars are placed in this position they are gaged for coupler height and side-bearing clearance, then raised by overhead crane, placed on horses and trucks removed, this being the only point where cars are raised off of trucks while passing through the various positions. Couplers and draft gears are lowered on all cars. Trucks, couplers and draft gears are given careful inspection and a work card authorizing all work necessary is attached to the car. While car is in this position repairs are made to buffer blocks and center plates. The triple valve is removed and sent to the air-brake department for repairs and testing, brake cylinder and reservoir are removed if defective, and all brake-cylinder, reservoir and brake-pipe supporting bolts tightened or renewed. Brake cylinder and auxiliary tube are cleaned, piston or piston packing leather renewed when required, and brake cylinder lubricated. Triple valve, end nipples, angle cocks, and air hose are applied, any other defects repaired, and brake levers checked for compliance to information shown on badge plate. Floor stringers are applied, if defective, and all floor stringer bolts are tightened or renewed. After the above repairs have been completed, center plate and side bearings greased, the car is then lowered onto the

Truck work is performed in position No. 4 while cars are supported on horses

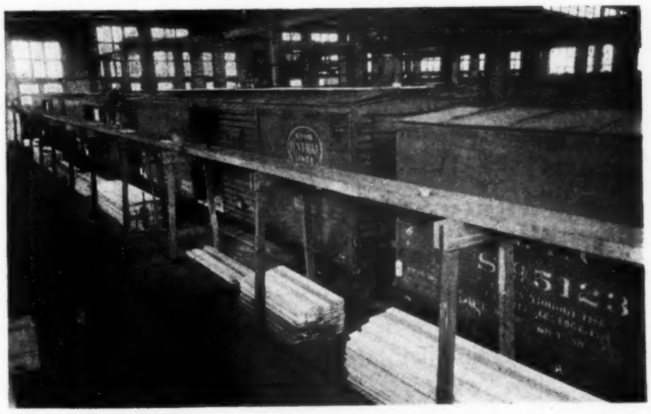
trucks. Journal boxes are repacked, after which coupler height and side-bearing clearance are again gaged and adjustments made if necessary.

Work in Later Positions

In position No. 5 safety appliances are applied, side doors fitted and made operative and door hasps fitted to door locks. Material men place required material for wood framers inside of car, except floor stringers which are applied on the truck position, and car is then moved to the next position. While on positions Nos. 5 and 6 the cars are in middle or old shop and as this shop is not equipped with an overhead crane, the cars are moved by power truck or tractor.

Position No. 6 is devoted to wood framing. All framing for door-post fillers, side-lining nailing posts, corner posts, inflammable signboards and routing card boards are attended to in this position. Touch-up prime coat painting, such as rivet heads, castings, etc., is also taken care of. The required amount of floor and end lining is now placed in the car.

Position No. 7 is devoted to the application of flooring and end lining. All flooring and end lining is cut to length and framed in the wood mill, except boring holes for floor rivets or bolts, which is done at the car.



Position No. 8 is provided with permanent scaffolds for convenience in applying roofs and running boards

Two-man gangs are employed in this position who apply flooring and end lining and bore holes for floor rivets or bolts. Annealed floor rivets are applied and riveted cold with a pneumatic riveting hammer.

Position No. 8 is devoted to application of grain strips, side lining, roofs, running boards and testing brakes. This position is equipped with permanent scaffolds for the benefit of men applying roofs and running boards. Small materials, such as bolts, nuts, washers, etc., are conveniently located on the scaffold and running boards are placed at each car by material men where they can be readily reached by workmen without leaving the scaffold. At the time running boards are applied other men are employed inside of the car applying grain strips and side lining. End of flooring at point of contact with side sheets is covered with flexible car cement and grain strips are applied on top of the wet cement. This provides a sealed joint and prevents grain or other commodity leakage. Air brakes are tested with a single car-testing device and a brake-cylinder leakage testing device. Grain strips and running boards are framed and cut to length in the wood mill before delivery to cars.

This position, on account of being equipped with scaffolds, is used when repairing cars which require complete renewal or application of all-steel or outside metal roofs. All-steel roofs are assembled on portable jigs and riveted with a gap riveter. Running boards are applied to the roof after it has been removed from the jib. The completely assembled roof is placed on the car by means of overhead crane and special carrier. In this operation the only work done on the scaffold is the riveting of the roof to the car body and securing running boards to end brackets. On cars equipped with outside metal roof the roof sheets and other roof parts are placed on scaffolds by material men so that the roof can be applied readily.

After cars are finished in this position they are pulled out of the shop at the north end with a power truck.

In position No. 9 the cars receive a second coat of paint and a third coat after a lapse of three or four hours, weather permitting. This is made possible by the use of approved fast-drying paints. All paint is applied by spraying machines. After working hours all cars on which painting has been completed are taken by the shop engine to the scale track and reweighed. Cars are then placed on the delivery track where they are stencilled the following day.

All nails inside of car are set 1/8 in. below surface. Cars are given a final inspection, particular attention being paid to journal-box packing and safety appliances. Air and hand brakes are then given a final test.

EDITORIALS

Car Construction— A Field for Welding

The latest contribution to the development of passenger equipment is a train designed to operate at high speeds which is of unusual interest to the car designer because of the low weight of the complete train. This light weight was obtained by the extensive use of high-tensile stainless steel in thin sheets and formed sections. The employment of such material was made possible by a highly developed process of spot welding in which the duration of time and intensity of the electric current is accurately governed to prevent overheating of the metal surrounding the weld.

In several European countries — noticeably Great Britain, Holland, Italy and Germany—welding is now extensively employed as a substitute for riveting in building up passenger-car bodies and trucks. Here, also, a saving in weight was a very important, if not the controlling, factor in the selection of the process. Welding not only saves the weight of rivets and laps, but also permits the use of thinner sheets and sections because they are not weakened by holes for rivets. On a number of European railroads welding has been placed on what is practically a production basis and low costs have been obtained. This has been secured by the development of many ingenious jigs and devices for assembling, holding and clamping the various pieces while they are being welded together. A good example of the means employed is the rotating jig or frame for welding up the bodies of the high-speed, Diesel-electric cars for the Netherlands Railways illustrated in the *Railway Mechanical Engineer*, April, 1934.

Welding has been employed in a limited and experimental way in this country for the fabrication of freight cars and several all-welded cars have been built. Had it not been for the practical cessation of car building for the past few years, other cars of similar character would doubtless have been constructed. With an increased activity in car construction it would seem as though attention should be given to a consideration of what may be found to be a very important field for welding in such work.

What Kind of Locomotive-Miles?

On April 24 Co-ordinator Eastman sent out to the presidents of the Class I railways the report of the Section of Car Pooling on the first part of its study of the returns on the questionnaire dealing with the motive-power situation. In the summary of the report O. C. Castle, director of the Section of Car Pooling, after discussing the facts developed by the study of steam locomotive utilization, concludes that "there is ample power, if adequately maintained, to protect any probable increase in traffic in the near future." He points out, however, that "this does not imply that it may not be economical or desirable to purchase new power," and calls attention to further information developed in a study of form CP-3 to be made available shortly that may be helpful in aiding the railroads to determine the economic life of motive power from the standpoint of cost of repairs.

In the meantime it may be worth while to analyze the sources of the additional locomotive miles which, according to the estimates of the railways, can be obtained by a full-capacity utilization of all motive power during a two-months' peak period, to see whether these miles are relatively of the same value as the miles actually made during August and September, 1933, the months chosen as the base period for the study.

The carriers' estimate of the maximum mileage possible during this period is based on the assumption of a two-months' double-shift operation of all repair facilities prior to and extending through the 61-day period of assumed maximum demand. It entails the increased mileage obtainable from the locomotives actually in service on October 1, the mileage obtainable from the locomotives stored serviceable as of October 1, and the mileage obtainable from the bad-order locomotives to be restored to service under the assumed conditions.

Obsolete Locomotives Do Their Part

On another page in this issue, in the summary of the report, are presented the results of this study. Considering road locomotives only, 26,583 locomotives out of a total ownership of 42,622 were in operation on October 1 and produced an average daily mileage of 2,505,000. By an increase in miles per locomotive per day these same locomotives are considered capable of making a daily average of 3,506,000 miles during the 61-day period of peak demand. By withdrawing 4,640 locomotives from storage an additional daily mileage of 534,000 is obtainable, and by repairing 9,604 locomotives 977,000 additional miles per day are secured. In this way a maximum daily mileage of 5,017,000 is arrived at.

There are six types of locomotives which, as a whole, may be considered obsolete. These are the Consolidation, 10-wheel, Mogul, Atlantic, Prairie and American types. The Consolidation type is still by far the largest single group of locomotives in the inventory. As a whole, this type averages 25.9 years of age, and the others mentioned vary from an average of over 26 years to over 30 years of age. There are 19,276 locomotives of these six types, or about 45 per cent of all the road locomotives owned. On October 1, 11,039 of these locomotives were in service, of which 6,681 were Consolidation type locomotives. These 11,039 locomotives were 41 per cent of the total number of road engines in service. They averaged 715,000 miles per day, or only 28.5 per cent of the total daily locomotive mileage made during that period. It is estimated by the railroads that these same 11,039 locomotives could be made to deliver 1,159,000 locomotive-miles daily, or 33 per cent of the peak daily mileage obtainable from the 26,583 locomotives in active service on October 1.

The locomotives of the six obsolete types to be withdrawn from storage number 2,606, or 56 per cent of all withdrawals from storage and are to be called upon to produce 238,000 miles per day, or nearly 45 per cent of the total daily locomotive mileage to be secured from stored locomotives.

Of the total number of locomotives to be repaired under the assumed conditions, 4,434, or 46 per cent, belong to these six types of power and are expected to produce a daily average of 327,000 miles, or about one third of the total to be obtained from repaired motive power.

Adding the mileage to be obtained from all sources, approximately 1,100,000 miles of the total daily increase of 2,512,000 miles more than were made during August and September, or about 43 per cent, are to be obtained from these six types. Of the total peak mileage of 5,017,000, these obsolete types are expected to furnish 1,724,000, or over 34 per cent. These figures show clearly how heavily the railways are leaning on their oldest and most obsolete power in this estimate of maximum capacity.

The Contribution of Modern Power

In the utilization study only those types which include over one per cent of the locomotive inventory are given separate listings. All of the locomotives of the most modern types—those with four-wheel trailer trucks, of which there are 1,272—are included in a group of 2,108 locomotives designated in the table as "Others." A comparison of the actual and the estimated peak performance of this group with the actual and estimated peak performance of the Consolidation type, throws further light on the value of the increased locomotive mileage by which the peak performance is to be made possible. In August and September, 1,533 of the 2,108 locomotives in the "Others" group made 227,000 miles daily—9 per cent of the total. For the two months' peak the same locomotives are considered capable of a maximum of 267,000 miles per day. By withdrawing 198 of these locomotives from storage and repairing 348 of them, 81,000 miles are added, making a total for the peak period of 348,000 miles from this group. This is only 7 per cent of the total daily mileage obtainable during the peak period.

The 6,681 Consolidation type locomotives in service on October 1 averaged a daily mileage of 411,000 during August and September—16.4 per cent of the total. By more intensive utilization these locomotives are considered capable of producing 652,000 miles a day, an increase of more than 50 per cent. By withdrawing 1,215 from storage and repairing, 2,818 more of them 313,000 more miles could be secured from this group, making a total of 965,000 miles, or over 19 per cent of the five-million peak. In other words, while it is possible to secure from the group of locomotives within which all of the most modern power is included an increase of but 53 per cent from the total daily mileage made during August and September, the Consolidation type locomotives will contribute an increase of 134 per cent over their August and September service.

It is evident that the railroads have been making such intensive use of their modern motive power, the supply of which is small at best, that there is relatively little reserve capacity for an extensive increase in demand. It is also evident that unless 40 per cent of the contemplated increase in locomotive mileage demand is to take place on branch lines and in other light services, in which some use of locomotives of the Consolidation, 10-wheel, Mogul, Prairie and American types can be made, no such increase as estimated can practicably be handled with the present locomotive inventory. What the effect on the cost of maintenance of repairing over 2,800 Consolidation type locomotives alone and 4,400 locomotives of the six old types combined is another question. On that the further report from the Section of Car Pooling will, no doubt, shed much light.

Paint-Shop Problems

If the damaging effects of time and the elements on railway equipment are to be checked and kept within reasonable limits, the railways will have to purchase and apply more paint-protective materials in 1934 than they did in 1933. While freight equipment is doubtless in need of the most attention as regards painting, the exterior finish of passenger equipment also has been allowed to deteriorate and the following list of questions pertaining to passenger-car paint-shop operations indicates the kind of problems which now confront paint-shop foremen and supervisors. What type of primer can be used which will adhere to aluminum metal car surfaces from 8 to 10 years, as does the primer now in use for similar steel surfaces? What system of painting wooden sash will give a service life from general shopping to general shopping without repainting while the cars are in service? What method can be developed by which glass in passenger-car sash may be cleaned more economically after the sash are painted than by the present relatively slow, hand method?

Other questions pertaining to details of paint-shop operations and methods of procedure are, for example: What mechanical rubbing device can be used to eliminate hand rubbing and sanding on varnishes and surfaces, etc., and produce satisfactory results? What is the most efficient method of exhausting the spray mist from the interiors of passenger cars when applying paints and varnishes with a spray gun? What method or materials may be used for removing paint economically from Agasote ceilings or headlinings of passenger cars without injury to the material, varnish removers, sandblasting, burning with a torch, and other methods, having proved too expensive or otherwise impractical? What method of lettering may be satisfactorily used, with particular reference to the spraying of "Gold Size Japan" before laying gold leaf? What is the most serviceable and economical finish for the passenger-car exteriors, lacquer or the new synthetic finishes? What finish can be developed and used for wooden floors and passenger cars and give a greater service life than the materials now generally in use? Are the glazing, composition and surfacers now generally used on the exteriors of passenger cars as fillers likely to add to or detract from the life of the whole paint film; or would a more serviceable and economical finish be obtained by eliminating both the surfacer and the glazing composition?

Why Handicap Good Machines With Poor Tools?

Railroad shops are quite frequently the object of criticism because of the fact that they are equipped with so many machine tools that are not capable of turning out work as rapidly and efficiently as could be done with up-to-date machines. This criticism is serious enough in itself, but no more so than the numerous instances that are to be found where a modern machine is purchased and installed and the railroad fails to get out of the machine the work of which it is capable.

The primary objective of installing a new machine tool is to produce better workmanship at a saving in time and cost. There have been many cases where new machines have been purchased without accomplishing

this desired objective and, in most instances, the purchaser is liable to feel that the new machine has been a poor investment, whereas if a careful study were to be made of all of the factors involved it might be discovered that the real reason for the unsatisfactory output is poor tools. Tools—the right tools—plus a good machine are the best assurance of maximum output and high-grade workmanship.

Generally speaking, there are four factors which have a tremendous influence on the problem of tools for metal-working machinery—the proper tool steel, correct heat treatment, accurate grinding and an adequate supply of tools at the machine.

In considering the question of tool steel it is just as important to know what kind of tool steel is best adapted to a specific job as it is to know which is the best grade of tool steel. Many railroad shops are open to severe criticism for permitting the question of price to enter into the selection of tool steel. In one recent instance a railroad saved less than one dollar a pound on tool steel for a certain machine and this small saving was responsible for a loss of over seven hundred dollars in labor—in this case, almost exactly the interest on the investment in the machine involved. So, it is vitally important that, first, the proper kind of steel be selected for the job in hand and, second, that the best quality of steel of that kind be purchased. Exhaustive tests, a comprehensive investigation of practices in other shops and the advice of reputable manufacturers will go a long way toward eliminating the losses due to the use of improper tool steels.

Heat treatment plays a most important part in assuring maximum and efficient tool service. This problem gives rise to the question as to whether it is more economical for a railroad to purchase its metal-working tools already heat treated, or to perform this work in its own shops. Before attempting to answer this question it must be recognized that the best tool steel made, if improperly heat treated, is certain to render unsatisfactory service and that proper heat treatment is an exact science requiring adequate facilities, trained workmen and a wealth of experience. It is logical, then, to assume that, for roads with small shops at least, it would not pay to build up an elaborate heat-treating department, but that it would save the company money if tools were purchased, ready to use, from reputable manufacturers. This would, at least, simplify the problem of fixing the responsibility for poor tools. For the larger shops, if it is considered advisable to prepare their own tools, the best in heat-treating equipment is none too expensive. In this connection modern electric heat-treating furnaces, with automatic temperature control, meet the requirements of this exacting service in an admirable manner.

It is to be admitted that many of our older machine hands take a great deal of pride in their ability to grind tools by hand, but experience has proved that the best of them cannot equal the precision of modern tool-grinding equipment. Many of the machine operations encountered in every-day railroad shop work are of a type in which the difference between a tool properly ground and one improperly ground represents the difference between success and failure—and tool failures on big machines cost real money. On wheel turning, for example, tool steel that cannot stand punishment is a definite production handicap, but the finest tool steel made will not stand up if the tool is not ground with the proper contour and clearance. Better machine performance will result if tools are ground to a standard by the proper tool-room equipment and supplied to machine operators in such quantities as will make it unnecessary at any time for a mechanic to shut down an expensive machine to grind tools or to lose time because the tools supplied him are short lived.

Are you handicapping your machines by using poor tools?

NEW BOOKS

Dardelet Thread Handbook. *Published by the Dardelet Threadlock Corporation, 120 Broadway, New York. 220 pages, 4½ in. by 7 in. Price, $2.*

This handbook, for engineers, designers and mechanics, contains both theoretical and practical information relative to the Dardelet thread, other thread forms and thread-locking devices. There are chapters on Theory and Design, Tests, Dimensions and Specifications, External and Internal Dardelet Thread Forming, Heat Treatment, Plating, Applications of the Dardelet Self-Locking Screw Thread, etc. The purpose of the Dardelet Self-Locking Screw Thread is to provide an improved screw coupling, such as a bolt and nut, which permits ready assembly and disassembly of the co-acting threads by a relative turning movement effected by a wrench or other suitable tool, but prevents accidental unscrewing.

Proceedings of the International Railway Fuel Association, 1933. *T. Duff Smith, secretary, 1660 Old Colony Building, Chicago. 126 pages, bound in red leather.*

The proceedings of the International Railway Fuel Association for 1933 contain the minutes of the twenty-fourth annual meeting held at the Sherman Hotel, Chicago, Friday, June 16, 1933, also seven committee reports. The report of the Committee on Front Ends, Grates and Ash Pans deals with two subjects: (1) The Cyclone Front End—the experience of the Northern Pacific with this front end, its development by the Locomotive Firebox Company, and tests of the Type C Cyclone arrester on the Soo Line, and (2) a summary of the results of a study of front-end action and tests on a front-end model recently completed by the Department of Railway Engineering of the University of Illinois. The Committee on Fuel Accounting and Statistics calls attention to certain data reflecting changed or changing conditions and the possible necessity of making at a later date rectifying provisions in the prescribed accounts. The ever-changing conditions which impel a change from time to time in ideas and standards of operations are discussed in the report of the Committee on Inspection and Preparation of Coal. The Relation of Pyrometers to Fuel Economy, the value of brick arches on present locomotive operation and grates are the topics given particular consideration in the report on Locomotive Firing Practice—Coal Section. The report of the Committee on Stationary Power Plants—Oil-Fired Power Plant Auxiliaries is on boiler-feed pumps, boiler feedwater heaters, fuel-oil pumping sets, fuel-oil heaters and oil strainers. A brief summary of the available information covering steam turbine and condensing locomotives in foreign countries is given in the report of the Committee on Steam Turbine and Condensing Locomotives. This is followed by a more complete discussion of the development of this type of equipment in America, with drawings showing the general arrangement and the detailed parts of condensing locomotives.

With the

Car Foremen and Inspectors

Work of the Bureau of Safety*

By W. J. Patterson†

THE scope and importance of the work of the Bureau of Safety are perhaps not fully appreciated except by a comparatively few persons who are closely in touch with its various phases. A considerable number of laws and provisions are administered by this bureau.

Under the safety appliance laws standards are prescribed for equipment and devices required to be installed and maintained on cars and locomotives for safety in operating trains and switching cars; the administration of these laws has effected a material reduction in occupational hazards of employment in railroad train service and has been of vast benefit to millions of railroad employees.

The hours of service law limits the periods on duty, and prescribes necessary off-duty periods for rest, of train-service employees, operators and dispatchers. Cases of excess service by employees of these classes has been reduced from considerably more than 300,000 in 1913 to only slightly more than 3,000 in 1933, thereby relieving nervous strain and greatly reducing the possibility of errors on the part of fatigued employees which lead to railroad accidents.

Under the accident investigation law thorough and impartial investigations of serious railroad accidents are conducted and reports are issued setting forth the facts and recommending preventive measures. These reports have led not only to correction of conditions which have caused accidents but the dissemination of information contained in these reports has resulted in the correction of similar practices on other roads which sooner or later would have resulted in serious accident. Furthermore, the fact that such investigations are conducted has had a salutary effect in relieving any suggestion that blame has been unjustly placed in determining the causes of accidents which are due to circumstances or conditions beyond the control of employees directly involved, or that important information concerning such accidents, in which the public is vitally interested, is being suppressed.

The Bureau of Safety administers orders issued under section 26 of the Interstate Commerce Act, requiring installations on certain railroads of automatic train stop, train control and cab signal devices. At the time of this enactment serious railroad accidents of the type that these devices were designed to prevent were all too frequent; this condition has now to a large extent been corrected, and it is no exaggeration to say that administration of this section of the law has been an important factor in providing increased safety in railroad travel and in reducing the number of disastrous accidents.

The bureau actively participates in investigations and experiments looking toward the development and adoption of improved railroad appliances; it examines and reports upon new inventions which are designed to promote safety of operation; it investigates instances of heroism and makes reports and recommendations upon which are based the award of medals of honor by the president of the United States.

Handling Car with Defective Safety Appliances

You are directly interested in the safety appliance law and related rules as applied to the interchange of cars. Let us see how the law operates with respect to a particular interchange movement. A proviso in section 4 of the act of April 14, 1910, reads as follows:

"*Provided,* That where any car shall have been properly equipped, as provided in this Act and the other Acts mentioned herein, and such equipment shall have become defective or insecure while such car was being used by such carrier upon its line of railroad, such car may be hauled from the place where such equipment was first discovered to be defective or insecure to the nearest available point where such car can be repaired, without liability for the penalties imposed by section four of this Act or section six of the Act of March 2, 1893, as amended by the Act of April 1, 1896, if such movement is necessary to make such repairs and such repairs cannot be made except at such repair point; and such movement or hauling of such car shall be at the sole risk of the carrier, and nothing in this section shall be construed to relieve such carrier from liability in any remedial action for the death or injury of any railroad employee caused to such employee by reason of or in connection with the movement or hauling of such car with equipment which is defective or insecure or which is not maintained in accordance with the requirements of this Act and the other Acts herein referred to; and nothing in this proviso shall be construed to permit the hauling of defective cars by means of chains instead of drawbars, in revenue trains or in association with other cars that are commercially used, unless such defective cars contain live stock or 'perishable' freight."

This prescribes the very limited conditions under which a car having defective safety appliance equipment may be hauled without liability for the penalty prescribed, and the following points should be noted.

1. Privilege of hauling a defective car for repairs is granted only when the car had in the first instance been properly equipped and thereafter became defective while being used.
2. It may be hauled only by the carrier upon whose line the equipment became defective.
3. It may be hauled only from the place where the defective condition was discovered to the nearest available point where car can be repaired.
4. It may be hauled only if such movement is necessary to make the required repairs and if these repairs cannot be made except at such repair point.
5. Carrier assumes entire responsibility for risk of death or injury in connection with such movement.
6. Movement of chained up cars in revenue trains is forbidden except when they contain live-stock or perishable freight.
7. Proviso relates only to the movement of a car for repair after it has been discovered to be defective and does not relieve the carrier from liability for hauling a defective car before the defect has been discovered.

It will, therefore, be seen that the law prohibits any carrier from hauling a car with defective safety appliances to an interchange track for the purpose of delivering it to a connecting line, and likewise it prohibits a receiving line from accepting and hauling a car with such defective equipment for any purpose. Therefore, to save a penalty to both carriers it is imperative that all cars be inspected and repairs made before the car starts on its journey to a connecting line. That is a simple rule and easily understood yet during the year 1933 here in Indianapolis, out of a total of 8,445 cars

* Abstract of an address at the April 2, 1934, meeting of the Indianapolis Car Inspection Association.
† Director, Bureau of Safety, Interstate Commerce Commission.

which were inspected by the Commission's inspectors when ready to move 278 or 3.4 per cent were defective and should have been repaired before discovered by our men. During this period several cars were actually moved in and about Indianapolis in violation of law under the observation of our inspectors.

The U. S. Circuit Court of Appeals for the Sixth Circuit summed up the situation well when it said:

"We find nothing either in the safety appliance acts or in any rule of the common law which requires a carrier to accept from a connecting line a car equipped in violation of the safety appliance act; and we are of opinion that it is both the right and duty of a carrier to refuse to accept such defective car in interchange when such acceptance would necessarily involve its own use of such car in violation of these acts." (Sanford, J., May 18, 1917, 242 Fed. 420.)

Movement of Trains with Brakes Inoperative

There is another provision with respect to the movement of a train; I mean the movement of any cut of cars upon which the air brakes are required by law to be used and operated. The provision which has the effect of law is contained in an order of the Commission dated June 6, 1910, and reads as follows:

"*It is ordered,* That on and after September 1, 1910, on all railroads used in interstate commerce, whenever, as required by the safety appliance act as amended March 2, 1903, any train is operated with power or train brakes, not less than 85 per cent of the cars of such train shall have their brakes used and operated by the engineer of the locomotive drawing such train, and all power-brake cars in every such train which are associated together with the 85 per cent shall have their brakes so used and operated."

This prohibits transfer or other trains from running along the road or between yards unless all the cars equipped with air brakes that are associated together have their brakes used and operated. *Any cars that have inoperative brakes must be switched to the rear.*

In order that the railroads and the commission may keep informed with respect to cars that have operative brakes and those having inoperative brakes, the Bureau of Safety and the A. R. A. agreed in 1925 upon the following rule:

"42. At point where motive power or engine crew or train crew is changed, tests of the train brake system must be made as follows: After the brake system on a freight train is charged to not less than 5 lb. below the standard pressure for that train, and on a passenger train to at least 70 lb., a 15-lb. service reduction must be made upon proper request or signal, brake pipe leakage noted as indicated by the brake pipe gage (which must not exceed 7 lb. per minute), after which the reduction must be increased to 20 lb. Then an examination of the train brakes must be made to determine if brakes are applied in service application on each car. When this examination has been completed, proper release signal must be given and each brake examined to see that it releases properly."

Cars picked up en route are treated under the following rule:

"43. When one or more cars are added to a train at any point subsequent to a terminal test the cars added, when in the position where they are to be hauled in the train, must be tested as prescribed in rule 42. Before proceeding, it must be known that the brake pipe pressure is being restored as indicated by the caboose gage and that the rear brakes are released. In the absence of a caboose gage, a test must be made as prescribed in rule 40."

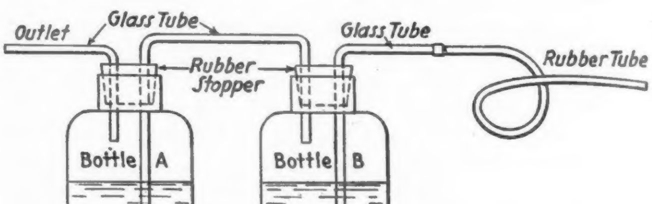
This procedure seems to be simple and easy of enforcement and observance, yet we find in this terminal the order referred to is constantly being violated, subjecting the carrier which violates it or the one that permits it to be violated to a statutory penalty of 100 dollars for each instance; this condition frequently results not so much because the law and rule are misunderstood as from activities of some enterprising subordinate who is undertaking to make a favorable record. The final result is embarrassment and financial loss to the company, and at the same time his activities subject employees to dangers which the law was intended to prevent. It is a short-sighted policy to ignore the purposes of this legislation and to disregard its specific requirements merely to avoid some temporary inconvenience. Such practices are not tolerated by railroad managements when called to their attention, nor by the courts or the administrative agencies of the Government. The requirements of the law are clear and well established; there can be no valid excuse for not conforming to them.

Smoke Gun for Testing Air-Distribution

*By T. W. Wigton**

NOW that the air conditioning of passenger car equipment is here to stay, the railway electrical engineers, or at least most of them, should be interested in any new or old devices which will make their problems in this field easier to solve. This refers particularly to equipment or apparatus for determining results of an air-conditioning installation, as regards temperature changes, water-vapor content of the air, and air movement, all of which are components of what is termed "Air Conditioning."

One of the handiest, simplest and most inexpensive contrivances for determining air movement is what could be called, for lack of a better name, a "smoke gun." With this device, one can determine accurately the movement of air in a car and can see just what is taking place as regards the air stream. However, the device to be described must not be confused with an anemometer or



When the operator forces air through the rubber tube, either by blowing through it or by using a hand bulb, a dense white vapor is emitted through the outlet from bottle A—This vapor is used in tracing air currents

a Katathermometer, which measures velocities or quantities of air, but it will be found to be a handy adjunct to test equipment, nevertheless.

As the sketch shows, the device consists of two large-mouthed bottles with rubber stoppers and glass tubing bent and installed as shown. Bottle "A" contains hydrochloric acid and bottle "B" contains strong ammonia. At the point marked "X" the end of the glass tube projecting down into bottle "B," a rubber tube should be attached. When the outfit is in use, the operator blows or puffs into this tube, or an atomizer bulb may be used and the device operated by pressure of the hand. Operation by either method forces ammonia vapor into bottle "A" where it combines with the hydrochloric acid causing a dense white vapor puff to be emitted from the outlet of bottle "A."

The odor of this vapor (ammonia chloride) is not unpleasant and while it is corrosive to metals if used in large quantities the small amount required to trace air currents in a car will do no harm to the car interior.

Users of this device will find it more useful and handy than the conventional smoke bomb. After setting up the outfit, all that is necessary, to produce puffs of "smoke," is to force a bit of air into the rubber tube either by blowing or by an atomizer bulb.

After the smoke gun has been used for some time, the operator will note a white deposit formed in the outlet tube. This deposit should be kept cleaned out and not be allowed to clog the glass tube.

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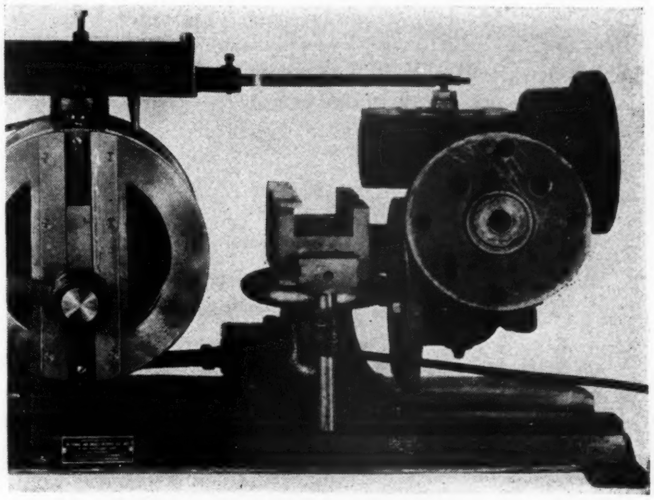
Lapping Machine for Air-Brake Valves

THE National Air Brake Service, Inc., San Francisco, Cal., has recently placed on the market a machine to lap air-brake slide valve seats mechanically. As is well known, the maintenance of air valves is one of the most important jobs in maintaining air-brake equipment to the high standard necessary to insure safety and efficiency in train handling. The machine, illustrated, is designed to save the labor of hand broaching or lapping and thus reduce the cost and time of reconditioning air-brake valves. It is being distributed through the Pacific Railway Equipment Company, 55 New Montgomery street, San Francisco.

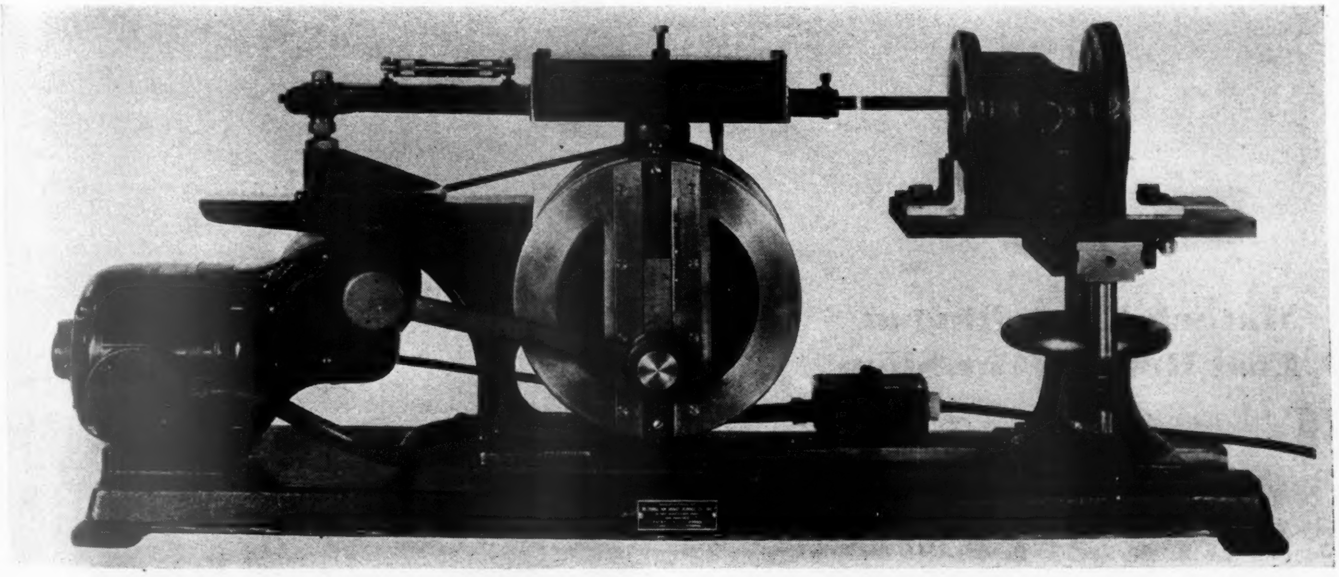
This machine is designed to lap locomotive distributing valves, feed valves, relief valves, and all types of triple valves, including the new "AB" type. Similar machines are said to have been successfully used for several years by one of the largest Class-I railroads, and have proved service records of performance and efficiency. One man with one machine in a western railroad shop is reported to have repaired and tested 726 triple valves in 193 hr., an average time of 15.9 min. per valve, at a cost of 21 cents each.

The machine consists essentially of a reciprocating arm with slotted weight in the center and a lap at the free end. The weight provides a 12-lb. downward pressure on the lap of special alloy metal, the diameter of which will vary for each type of valve. This lap rotates, is self-leveling and is grooved to handle properly the abrasive compound. The rotation is accomplished by contact with the side walls of the valve seat. When the lapping arm is running free, its weight is supported by a ball bearing in the top of an eccentric pin, the bearing surface of which is spring steel fixed in the top of the slot and which may be depressed into an inverted arc by an adjusting screw. This causes the middle of the lapping arm to move through an inverted arc and the lap to move inversely, which motion is necessary to wear down the ends of a valve seat low in the center. The eccentric pin moving in the slot and driven by a friction wheel on the inside of the fly wheel produces a lateral movement to the arm, which, in combination with the reciprocating motion, results in oscillating the lap. By disengaging the friction wheel which automatically centers the eccentric pin, a straight, horizontal movement of the lapping arm is produced and the length of stroke is adjusted between 0 and 6 in. by sliding the crank pin across the face of the fly wheel.



Close-up view showing the chuck arrangement for holding distributing valves

The machine is provided with a flat, horizontal chuck equipped with an adjustable vise to hold all types of triple valves; and a vertical, invertable chuck to hold locomotive distributing valves, feed valves, and relief valves in the necessary working position. Both chucks may be adjusted vertically, laterally and longitudinally to place the valve seats into proper relationship to the lap.

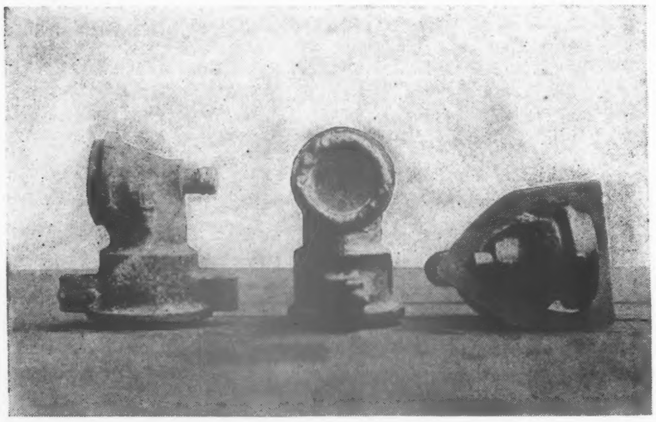


General view of National lapping machine as used in reconditioning a triple-valve slide-valve seat

The machine is driven by a ¼-hp., 1,750 r.p.m. motor, equipped with a 10 to 1 worm reduction gear, and further speed reduction is made through a V-type belt drive to obtain a lapping arm speed of 96 strokes per min. The machine weighs 250 lb. and occupies a bench space of 13 in. by 41 in. with an overall height of 18 in.

Reclaiming Metallic Steam-Hose Elbows

THE illustration shows the reclamation of metallic steam-hose elbows. The elbow at the left has been reclaimed by building up the pivot pin with bronze welding. The center view shows additional metal applied to the bearing and shoulder. The view at the right shows the elbow after it has been turned down to standard dimensions, the sheet metal gage showing the proper shoulder offset and the pointed end of the gage covering the proper height of the pivot pin.



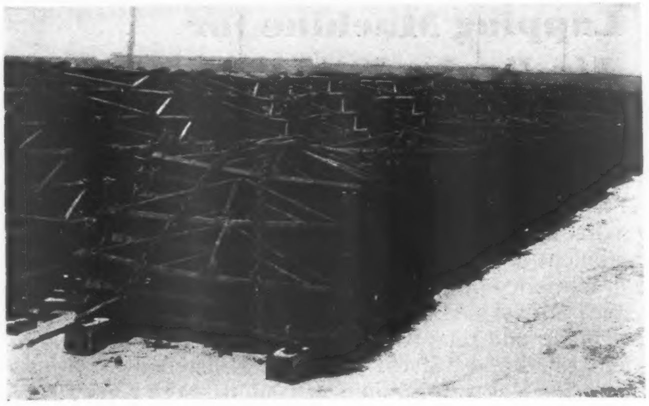
Method of reclaiming metallic steam-hose elbows by building up worn parts with bronze welding

Similarly, the S-310 coupler head is repaired by: (1) Filling in the stripped threads on the pivot pin for locking the lever, which permits re-tapping the threads; (2) brazing additional metal on the lug that engages the locking groove; and (3) adding metal to the lip of the coupler. Additional metal is also applied to the shoulder which can be turned down to the proper dimensions. Supporting lugs are brazed on when cracked or broken off.

Material Handling at East Buffalo Car Shop*

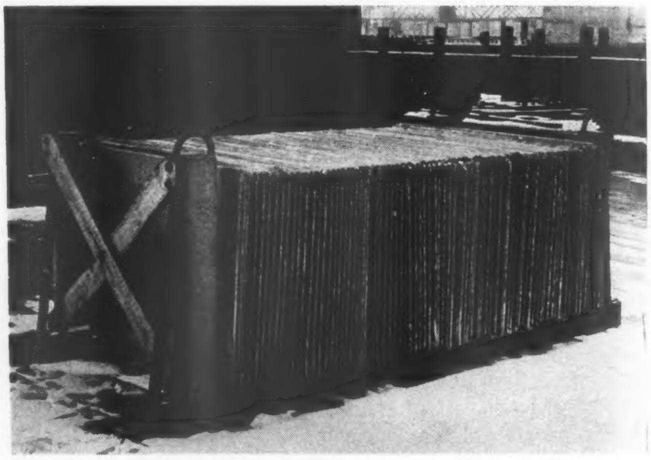
THE East Buffalo car shop of the New York Central is organized for the overhauling of box cars by the progressive system of freight repairs. The effective operation of such a system is dependent in a very considerable measure upon preparation and upon close cooperation between the car department and the stores department.

When a new repair program is being planned covering repairs to a designated number of freight cars, a number of the cars are inspected by the car department to ascertain amounts of various items of material required per car. This information is next checked with the latest drawings to determine if any changes in materials have been authorized. The stores department is then in position to prepare requisitions for the material required and orders are placed on the purchasing department with specified delivery dates. This is done to save unnecessary investments in stock and reduce duplicate handling to a minimum.



Brake beams are unloaded onto skids holding 50 beams for convenient reloading on flat cars for delivery to car shop

The shop storekeeper is in close touch with the material situation at all times and it is his duty to see that proper amounts are on hand and to supervise distribution to prevent a surplus of material at one position and a shortage at another. Much of the material is delivered to the shop in carload lots, unloaded by overhead cranes and placed on storage tracks in the different bays, so as to be readily accessible as required.



Metal roof sheets are loaded on special skids for transfer to car shop

A few of the methods employed, together with the skids and other equipment used in the delivery of ma-

Small parts are loaded in metal boxes on skids and moved by power trucks to the point where they are to be used

* Abstracted from a paper presented before the January meeting of the Eastern Car Foremen's Association by W. P. Hickey, district storekeeper, New York Central, East Buffalo, N. Y.

terials to the shop, are of particular interest and are shown in accompanying illustrations.

Brake beams for shop use are unloaded from the car directly onto skids of special design built to hold 50 brake beams. Six of these skids are loaded onto a flat car, delivered to the shop and unloaded with an overhead crane and placed in storage adjacent to the truck position. Empty skids are then loaded on the flat car and it is returned for further loading.

Steel doors are received in carload lots, unloaded inside the shop with electric crane, stored according to type and size in convenient locations and delivered to cars by material men from this point as required.

Metal roof sheets and other roof parts are stored under cover to prevent corrosion, all roof parts being painted before they are placed in storage. As the shop requires this material roof sheets are loaded on skids, as shown, which are in turn loaded on a flat car by an overhead crane and delivered to a point in the shop adjacent to the roof position. Small roof parts are loaded in skid boxes and delivered on the same car with the roof sheets.

Rough framing lumber is unloaded from cars and piled in the lumber yard. From this point it is loaded on hand cars or lorries and delivered to the wood mill for fabrication as required. Flooring and end lining are unloaded directly into the mill from cars. After this material has been fabricated it is loaded on skids and delivered to shop storage located at or near the point of consumption. From this point it is delivered to the cars by material men. Carloads of lining are placed convenient to the locations where used and unloaded and delivered by the material men on the station direct to the job.

Small parts are usually loaded into metal boxes of suitable size which are placed on skids for ready movement by power trucks to the different points in the shop where they are required. Throughout the shop and storehouse there is every evidence of systematic planning for a movement of all materials in such a manner that they will always be close at hand as required by the different gangs of men.

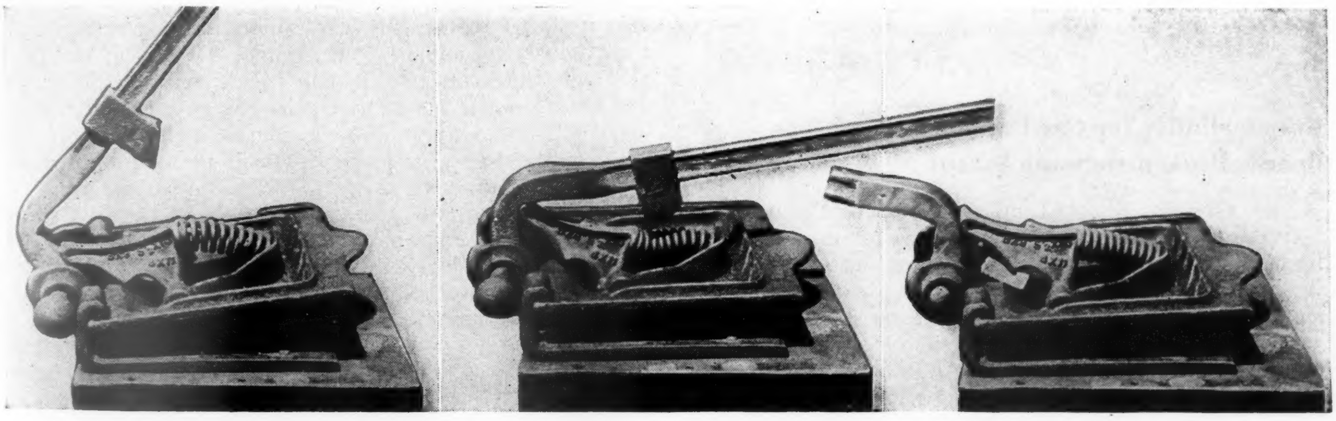
Applying Springs to Journal Box Lids

VERY often a broken coil spring or worn spring lever needs replacement in a passenger-car journal-box lid, in which case, the special tool illustrated can be used to good advantage. It can be made readily in any shop and consists simply of two strap-iron hook clamps, forged as shown in Fig. 1, and secured by screws to a board or to the top of a box, which supports the lid in a horizontal position, an offset hinged bar with sliding dog being provided for removing or applying the lid spring and lever.

To use the device, the lid is hooked under the clamps and the offset bar attached to the lid by slipping the hinge pin through a hole in the bar. In dismounting the spring, the sliding dog is moved down on the bar handle to a stop pin and the handle lowered and forced down until the dog presses on the coil spring and forces the spring lever out of the slotted bearings, as shown in Fig. 2. Removal of downward pressure on the handle and lifting it releases the coil spring and spring lever which may be readily removed.

To replace these parts, the sliding dog is slid out of the way and the spring lever and coil spring placed in position, the lever being forced into place by pressing down the bar handle. The application of the lid to the journal box is much facilitated if a block of wood 1 in. square and about 2 in. long is placed under the spring lever so that the lid can be hinged to the journal box easily. The block can then be knocked out, allowing the spring lever to bear against the box. Fig. 3 shows the reversed position of the tool to raise the spring lever for the purpose of inserting the block of wood.

This device can be mounted on a short piece of board instead of a box, if it is desired to carry it around the yard. However, if used around the shop, it is in a more convenient position if fastened to the top of a box.



Method of using a special tool recently made for removing and re-applying journal-box lid spring levers and coil springs
Fig. 1 Fig. 2 Fig. 3

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Cast-Iron Wheels in Place Of Wrought Steel—Stenciling Questioned

The Huntingdon & Broad Top Mountain substituted a pair of cast-iron wheels in place of multiple-wear wrought-steel wheels under a Western Maryland car account of cut journal covered by a Pennsylvania defect

card. Charge was made for second-hand cast-iron wheels applied and credit allowed for multiple-wear wrought-steel wheels removed. The Western Maryland requested defect card, claiming wrong repairs, and rendered bill against H. & B. T. M. for expense of replacing multiple-wear wrought-steel wheels under the car. The H. & B. T. M. refused request for defect card and refused to approve bill for payment, claiming wrong repairs had not been made. Failing to agree the matter was mutually referred to the Arbitration Committee. The H. & B. T. M. stated that when car was on shop track, a close inspection was made and no stenciling for wrought-steel wheels as required in Section a, paragraph 1, of Rule 70 was found. Notation "Car not stencilled for wrot-steel wheels" was placed on billing repair card attached to bill. To request for defect card from the W. M. was attached a joint-evidence card to show wrong repairs. The Western Maryland submitted evidence showing that when car was built new in 1928 it was equipped with four pairs of wrought-steel wheels and was so stenciled, stenciling being placed on side-sill extensions at each end of the car. When car was switched to have wrong wheels removed inspection showed that stenciling for wheels was dim but still legible.

In a decision rendered April 7, 1933, the Arbitration Committee said: "Car owner makes positive statement that car bore stenciling 'Wrought-steel wheels' at time cast-iron wheels were removed and supports its statement with joint evidence. The contention of the Western Maryland is sustained."—*Case No. 1726, Huntingdon & Broad Top Mountain Railroad & Coal Company vs. Western Maryland.*

Responsibility for Car Damaged, Roof Boards Broken to Some Extent

The Oregon Short Line delivered a Pacific Fruit Express refrigerator car to owner's shop at Nampa, Idaho, and, on inspection, the roofing was found damaged to the extent of 62 pieces top course and five pieces bottom course boards requiring renewal, which damage was repaired. Request to Oregon Short Line for defect card covering damage was refused with claim that damage was not cardable under Rule 4. The Pacific Fruit Express stated that the roof boards had been side-swiped and that ends were split and feather edged. They also stated that the Oregon Short Line in refusing defect card had at first contended that roof boards were not broken to any extent and that no repairs were justified, but at a later date did not question the necessity of repairs but had held that they should be relieved of responsibility for damage in question. They contended that damage was cardable under Rule 4, Section e, inasmuch as failure to make repairs would have resulted in a leaky roof with possible damage to perishable commodities loaded in the car as well as to insulation. The Oregon Short Line said that car was jointly inspected before general car foreman and by the car foreman of the P. F. E. A lot of correspondence between the two companies was submitted. It was acknowledged by the O. S. L. that the roof boards were split or broken to some extent and had been slightly raked which resulted in ends being feather edged, but claimed that damage was not sufficient to come within the extent of making it a cardable defect under Rule 4, Section e.

In a decision rendered October 26, 1933, the Arbitration Committee said that "The evidence submitted in this case indicates that the roof boards in question were damaged sufficiently to make them cardable, under Rule 4, Section e. Therefore, the contention of the Pacific Fruit Express Company is sustained."—*Case No. 1728, Pacific Fruit Express Company vs. Oregon Short Line.*

Interchange of Loaded Car with Wheel Defects Requiring Renewal

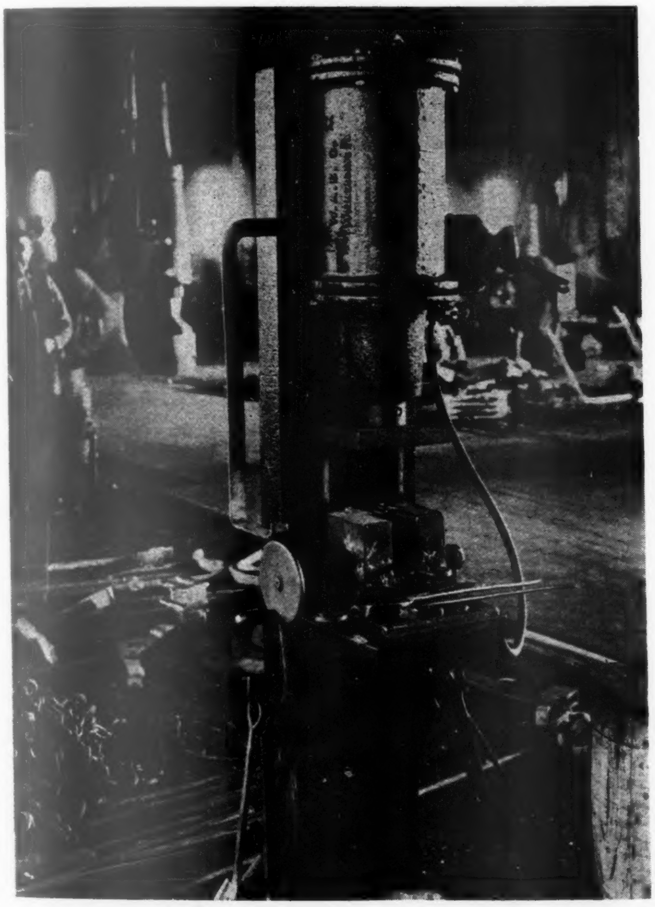
The Chicago, Indianapolis & Louisville delivered in interchange a Cleveland, Cincinnati, Chicago & St. Louis car loaded with coal to the Chicago, South Shore & South Bend. Inspection made by the C. S. S. & S. B. inspector before switching the car revealed that one wheel had a broken rim about 10 in. long and 4 in. of flange cracked. The C. S. S. & S. B. refused to accept the car. The C. I. & L. having offered the car in interchange refused to make repairs. The C. S. S. & S. B. stated that wheel had broken rim and cracked flange as set forth in agreed statement of facts and that the mate wheel was worn through chill which rendered car unsafe to handle as per A. R. A. Rule 2 which states: "Paragraph a, Cars (whether loaded or empty) having defects in violation of Safety Appliance Acts should not be offered in interchange." Reference was also made to interpretation of Arbitration Committee as follows: "Inter. (1) Q. Can a car be refused account welded truck side which may have been welded previous to January 1, 1920? A. Rule 2 gives the receiving line the right to refuse any car which in its judgment is unsafe for movement over its line. It is assumed that this question concerns a truck side with a defective weld." This interpretation, it is believed, indicates clearly that the committee considered it the right of receiving line to reject any car which in its judgment is unsafe for movement over its line. The Monon refused to make repairs unless the C. S. S. & S. B. authorized the expense of engine and crew to change the wheels, claiming that under Rule 2 such repairs were receiving-line responsibility and the car could not be rejected without first transferring the lading. Such expense would be an unnecessary expense to the C. S. S. & S. B. since repairs could be made under load. Paragraph (F), Item (9) of Rule 2 states: "(F) Transfer authority will not be issued account following defects: (9) Any other defects which can be repaired under load, or, if the car is safe to run and safe for lading, the receiving line to be the judge." Repairs were finally made by the C. S. S. & S. B., it being their contention, however, that A. R. A. Rule 2 gives the receiving line the right to reject this car on account of unsafe condition and that expense in excess of amount collectible from car owner, plus per diem, should be borne by the C. I. & L. Transfer of lading was not necessary, car being repaired under load. Failing to agree, the matter was referred to the Arbitration Committee. The C. I. & L. agreed to the facts, but contended that, in accordance with Rule 2, car should have been accepted by the C. S. S. & S. B. and either repaired or transferred.

In a decision rendered April 7, 1933, the Arbitration Committee said that: "Rule 2 reads in part as follows: 'Loaded cars offered in interchange must be accepted, with the following exceptions (a) to (e), inclusive.' These exceptions do not authorize the rejection of a loaded car for wheel defects. The contention of the Chicago, South Shore & South Bend is not sustained."—*Case No. 1727, Chicago, South Shore & South Bend vs. Chicago, Indianapolis & Louisville.*

In the Back Shop and Enginehouse

Pipe Clamp Forming Machine

An efficient shop-made machine for forming all sizes and shapes of pipe clamps commonly used in locomotive repair work has recently been developed, as shown in the illustration, at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific. It consists of an 8-in. air-brake cylinder mounted on a 12-in. channel which is set vertically in the blacksmith shop floor. The air cylinder is bolted to the upper end of



Pipe-clamp forming machine developed at the Milwaukee shops

the channel and provided with a flat die block keyed to the lower end of the piston sleeve.

An adjustable clamping die, made of a pair of jaws from an old 1½-in. bolt-threading chuck, is welded to the channel at a convenient height and forms the bottom dies used in making pipe clamps. These dies are adjustable horizontally for width by means of the hand wheel shown. Mandrels of the required shape and equipped with convenient handles are provided for use between the lower dies and the upper flat die secured to the piston sleeve. An outboard support for the stock which is being formed is provided, as shown at the left of the channel, and consists simply of a formed piece of ¼-in. by 1½-in. iron secured to one of the cylinder holding bolts.

In operation, the stock is cut to the right length for each size clamp and formed hot in one operation. All sizes of pipe clamps, from ¼-in. to 2½-in., are made with one adjustable die, which avoids the necessity of having a bottom die for each size pipe clamp, and saves set-up time.

The clamps are usually made in lots of 200 to 300, uniformly accurate shapes being secured at a minimum expenditure of time and labor. The various kinds and sizes of mandrels used are shown attached to a hook on the left side of the machine, also leaning against the machine base at the right.

In addition to forming pipe clamps, this machine is used for numerous other small forming operations, the necessary small dies being simply gripped in the adjustable chuck jaws.

Driving-Box Handling Truck

A convenient two-wheel truck for handling driving boxes at the Clinton (Iowa) shops of the Chicago & North Western is shown in the illustration. This device consists of a pair of 12-in. truck wheels, mounted on an axle to the center of which has been welded a substantial L-shaped steel bar and a handle. This holding bar, which supports the driving box and fits in one of the shoe-and-wedge ways, is made of 1¼-in. by 5-in. stock cut from an old arch bar, the vertical leg of the L being approximately 12 in. long and the horizontal leg 24 in. long. A round handle,

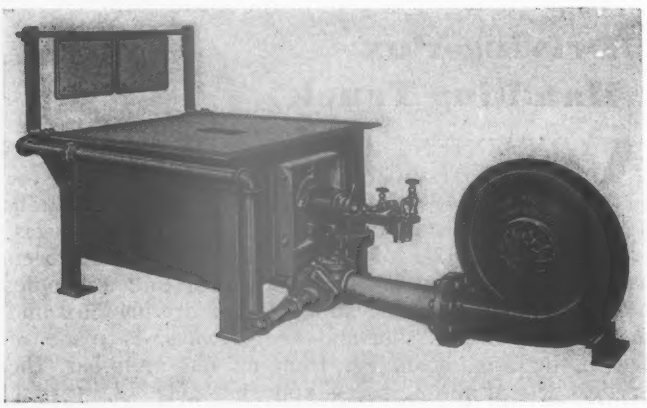
Safe and convenient two-wheel truck for handling driving boxes

welded to the horizontal leg, is provided with a cross bar at the outer end for convenience in handling.

The relatively large size truck wheels, with 2¾-in. face, facilitate easy movement about the shop, and the two-wheel truck arrangement without overhang enables the driving box to be moved through narrow places and readily turned in a space which would be too small for the passage of a four-wheel truck. Another important factor is the safety feature, in that the driving box, once loaded on this truck, can hardly be dislodged until purposely unloaded by tipping up the truck handle. Owing to the long leverage provided, one man can readily handle the largest driving box on this type of two-wheel truck.

Oil and Gas-Fired Blacksmith Forges

THE Mahr Manufacturing Company, Minneapolis, Minn., has developed an improved type of oil-fired blacksmith forge having air-curtain pipes and adjustable radiation shields, patented auxiliary air tunnel, twin oil strainer, and safety automatic shut-off oil valve. The use of this forge is designed to make it possible to realize on the following advantages of oil or gas fuel instead of coal or coke for heating in open-top blacksmith forges: Clean working conditions, reduced labor, quick heating, efficient use of fuel, and easy temperature regulation.



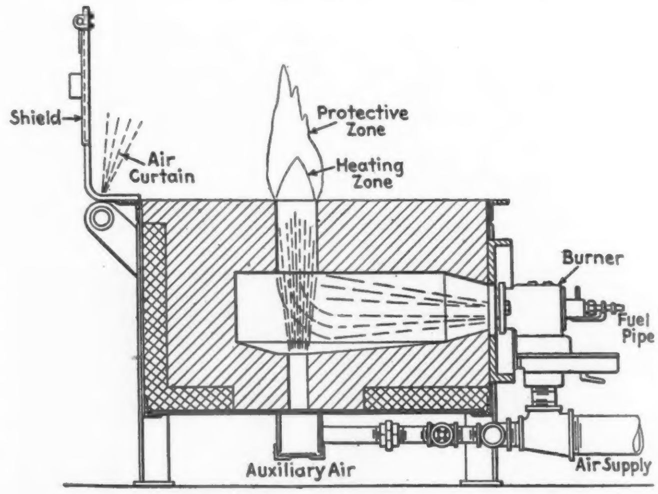
Improved type of oil-fired blacksmith forge developed by the Mahr Manufacturing Company, Minneapolis, Minn.

In connection with the latter advantage, coal and coke must be heaped on the fire at intermittent intervals. Fresh fuel cools the fire at first, then heating it to a maximum temperature and finally cooling it off as the fire burns out. Oil and gas on the other hand flow constantly at a uniform rate whether it is desired to have a high heat or a low heat. When coal and coke fuel beds burn thin, they allow more air to come through and scale the steel. The flame around the steel in an oil or gas forge stays the way the operator sets it with the valves.

The application of burners to blacksmith forges at first was accomplished by bricking up a right angle duct with the burner firing in a horizontal plane, the flame impinging the corner of the angle and deflecting upward to come out of the opening at the top of the forge. This method of firing was successful in some cases, and not so successful in others.

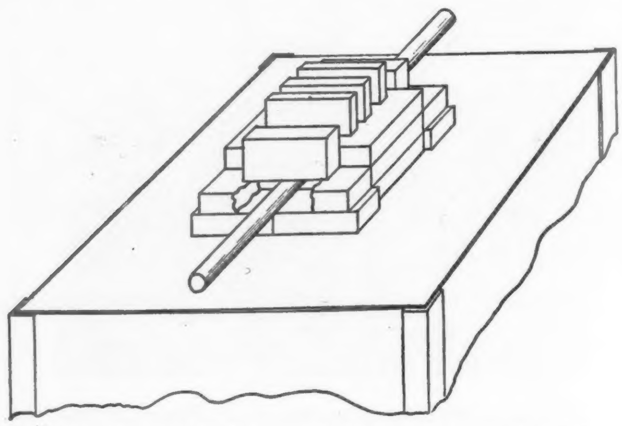
The cone-shaped flame of the Bunsen gas burner is generally familiar, as is the fact that the temperature and combustion conditions vary at different heights in the flame. Likewise, adjustment of the air inlet will raise or lower the tip of the inner and outer cones, illustrated.

An improved and patented feature of Mahr blacksmith forges, both oil and gas fired, utilizes this principle of cone adjustment in flames. It consists of an auxiliary air tunnel with outlet at the bottom of the forge and upward into the center of the vertical duct, as shown in one of the illustrations. The correct length of the vertical and horizontal ducts for different fuels and the adjustment of the auxiliary air in combination with the burner regulates the height of the cone and the point of maximum temperature as required for forging and welding operations on different size sections.



Cross-section showing the construction of the Mahr oil-fired blacksmith forge

The auxiliary air cushions the impact of the flame against the back wall of the forge and deflects it upward before it can impinge and concentrate the heat where it would melt the lining. It prevents the formation and accumulation of large slag puddles in the bottom of the forge. It accelerates combustion by the addition of air at right angles into a flame in the primary stages of burning.



View showing typical loose brick arrangement on top of forge

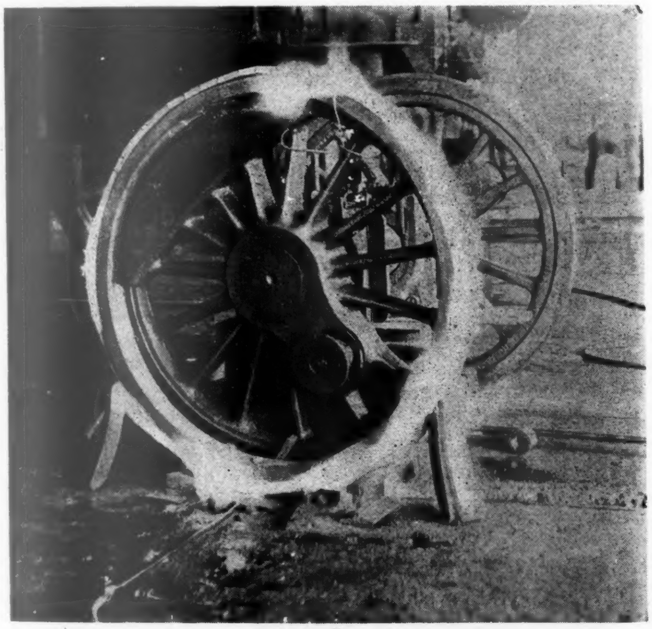
The forges may be furnished round or rectangular. The rectangular forge is easier to line with standard shaped firebrick. The round forge is the shape most familiar to old-timers in the ancient art of smithing and sometimes favored by them for that reason alone. Re-

gardless of shape, it is desirable to arrange loose brick around the piece being heated to concentrate the heat where it is most desired. This can be done on one or all sides and restricted or extended to various lengths, as illustrated.

The use of individual blowers is suggested for air supply regardless of the kind of fuel used, as a constant, steady air pressure is maintained, long leaky air lines are eliminated, single forges may be operated economically, and the initial investment is low.

Damaging Wheel Centers By Excessive Heating

THE number of cracked spokes and in some cases, wheel centers that were found on one railroad were traced to excessive heating of the wheel during the application of tires. An investigation disclosed that little thought was being given to this feature by the employes performing this work and frequently, while the tire was being heated, in much the same manner as is shown in the illustration, those assigned to perform this work engaged in some other job until they thought the tire



To avoid heating the wheel centers, one road uses dummy centers while heating tires

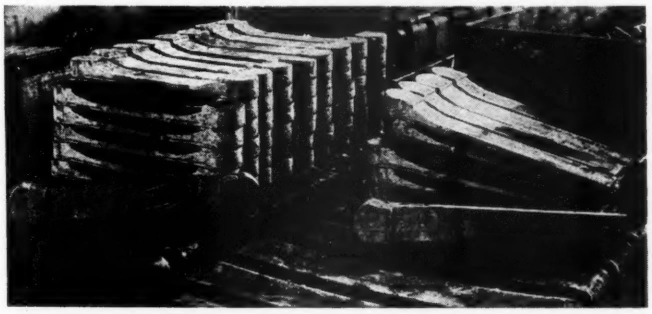
had been heated sufficiently to permit of its application to the wheel center.

As a consequence of this lack of attention the wheel center was usually excessively heated and during the shrinkage operation damage was being done to the spokes and other parts of the wheel.

If the expanding of tires is closely watched by competent mechanics and care is exercised to see that only the tire itself is heated there is no danger of damaging the wheel center; however the railroad in question has discontinued the practice of applying the tire to the wheel during the expanding process and has installed "dummy" wheel centers of suitable sizes at the various roundhouses and shops on which the tires alone are heated. They are then transferred to the wheel centers to which they are to be applied.

Making Spring Hangers Without Drilling

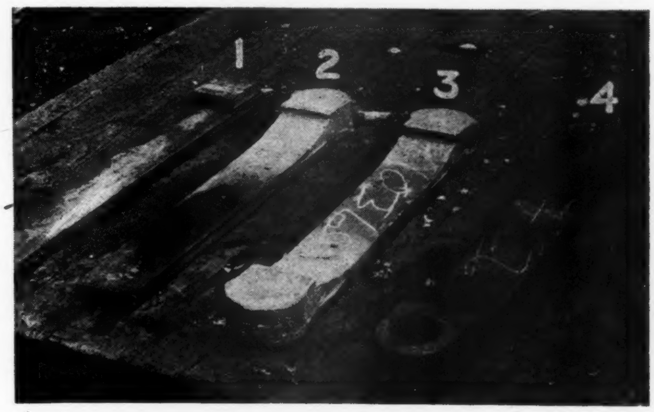
A NEW method of making spring hangers, which is now being tried at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific, is of special interest because hangers of standard size and good quality are secured without the necessity of any drilling operation for the application of the bushings. The



Spring hangers loaded on two lift-truck skids ready for punching the ends and insertion of hardened steel bushings

hangers are made of low-carbon steel so as not to harden appreciably when suddenly immersed in cold water, as required following one of the operations. The stock consists of ⅞-in. by 3½-in. material, to which is added a lap 3⅛ in. long on each end. In general, the method consists of forming the enlarged ends on the spring hangers in a forging machine, punching holes of the required size in the ends, and, while the metal is still hot, inserting casehardened bushings, the spring hangers then being cooled quickly in a water bath before the heat has had time to affect the casehardened bushings.

Referring to the illustration, the various operations in making spring hangers by this method are illustrated. The stock, sheared to the proper length and provided with a lap on one end, is shown at *1* in the first illustration. This blank is heated in an oil-fired furnace and upset in two operations on a 4-in. Ajax forging machine



Four steps in the manufacture of a spring hanger in which bushings are applied without drilling the hanger

to the shape shown at 2. In the first of these operations, the lap is welded to the main stock and the largest portion of the stock necessary to form the end of the hanger is accumulated. The second operation completes the upset on one end. It is necessary to make the hanger a little greater in width than the finished hanger in order

to provide for subsequent operations. The other end of the hanger is then forged, as shown at *3*. The concluding operation consists of reheating the hangers, one end at a time, and punching 2-$\frac{5}{16}$-in. holes, in which casehardened bushings are inserted, as mentioned, and the spring hangers cooled quickly in a water bath. The completed hanger is shown at *4* in the illustration, having been made without any drilling or machine-tool operations, except in the manufacture of casehardened bushings.

All spring hangers made by this method are tested on a special gage block to assure their being of the proper length, with holes parallel. This gage consists simply of a heavy cast-iron block in which positioning holes have been drilled with centers spaced to all standard spring-hanger lengths. Plugs of the proper size are provided for insertion in these holes, the enlarged upper ends of these plugs being a close fit in the casehardened bushings. Spring hangers are not accepted for use at Milwaukee shops or for shipment to other parts of the system unless they fit over these gage plugs and a high degree of accuracy is, therefore, assured.

Tool Drawers And Vise

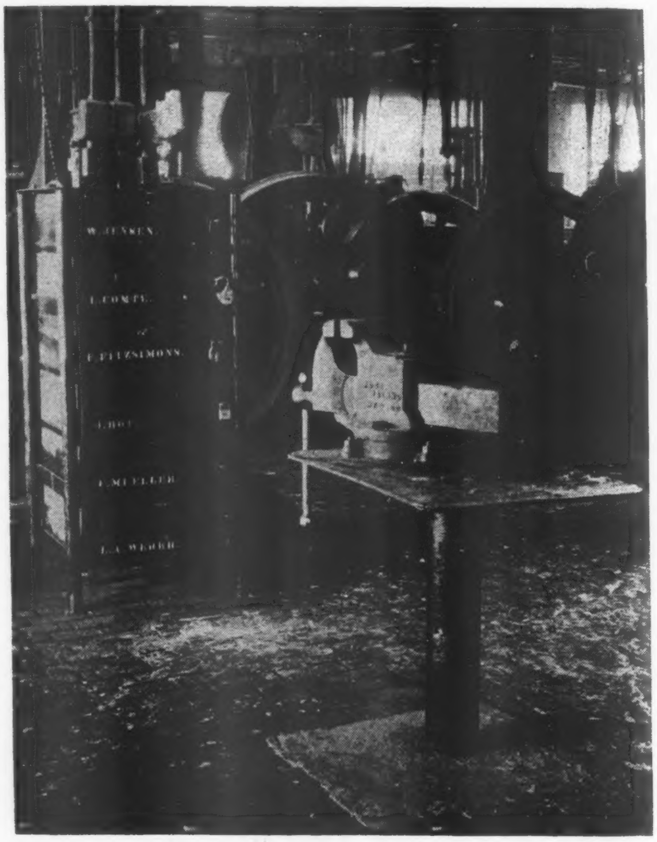
PARTICULAR emphasis is placed on order and cleanliness at the Clinton (Iowa) shops of the Chicago & North Western, and one factor which contributes much to this desirable condition is the use of vertically-stacked tool drawers for individual workmen; also numerous conveniently-located vise stands of the type shown in the illustration.

In many shops, machinists employed in the erecting department are assigned individual drawers in the conventional type of horizontal work bench, which, in addition to taking up a large amount of floor space, are frequently located against the walls or between the pits where they provide numerous dark corners and spaces in which much scrap and other material, as well as dirt, accumulate. This type of work bench has been completely discarded in the Clinton erecting shops in favor of the neat and convenient vertically-stacked drawers, illustrated.

The stand for holding the standard tool drawers, formerly used in the horizontal-type bench, is built largely of scrap material and consists of four vertical corner posts, 56 in. high, made of old boiler tubes which are spaced by, and firmly welded to, seven $\frac{1}{8}$-in. steel horizontal sheets which support the tool drawers and form a cover for the top drawer. The dividing sheets are flanged upward $\frac{3}{4}$ in. on two sides to facilitate sliding of the drawers. The names of individual workmen are stenciled on the drawers, which are locked by means of padlocks and hasps welded to the corner posts.

It will be noted that the lowest drawer is placed about 6 in. above the floor to facilitate cleaning underneath. In addition to promoting a clean condition of the floor, with attendant increased safety and ease of working, the vertical tool drawer arrangement, illustrated, gives more room between pits and more light.

The vise stand, conveniently located, as shown in the illustration, also is designed to take up a minimum of shop space and facilitate maintaining a clean floor condition. This No. 98 Rockford vise, with 7-in. jaws, is bolted to a $\frac{3}{8}$-in. steel plate, 30 in. long by 24 in. wide and located 28 in. high above the floor. The plate is welded onto the upper end of a section of a scrap superheater flue, set in a substantial concrete foundation in the floor. For suitable rigidity, this foundation block is made about 3 ft. deep. The vise-supporting plate, in



Convenient vertically-stacked tool drawers and rigidly-supported vise stand

addition to being welded onto the top of the superheater flue, is provided with two braces, welded in place as illustrated, to give additional stiffness and rigidity. In actual practice this vise stand construction has been found to have adequate strength, take a minimum space and facilitate maintaining a clean floor condition.

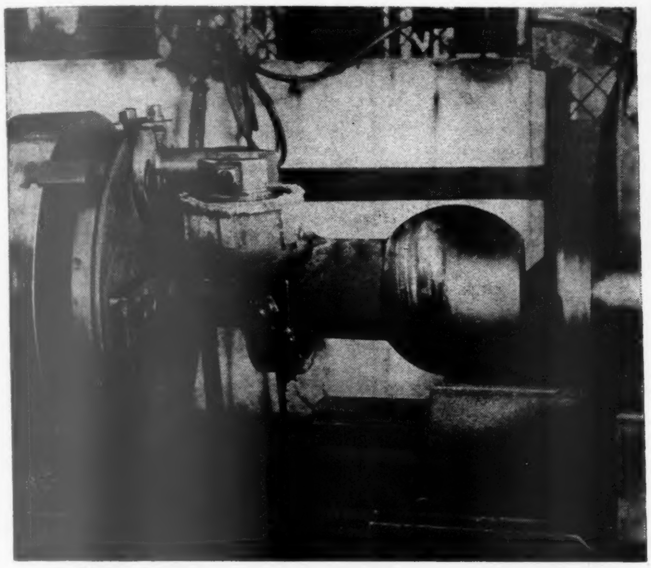
Machining Booster Steam-Pipe Balls

AN interesting method of reconditioning worn booster steam- and exhaust-pipe balls has been developed, as shown in the illustration, at the Clinton (Iowa) shops of the Chicago & North Western. These ball joints are subject to wear and cutting by the packing and gland and, as a result, steam leaks develop.

To avoid the expense of scrapping these worn ball joints, the general method of procedure followed at the shops referred to is to undercut the worn ball $\frac{1}{8}$ in. on the diameter and build up $\frac{1}{4}$ in. larger than the finished size—using a special bronze-welding material—then finishing the ball to the proper diameter, the same as when new. By this method a smooth and accurately-finished ball is obtained and the application of a special lubricating ring is expected to prevent further difficulties from this source.

To facilitate proper handling of the machine operations required in this reclamation job, an interesting

holding jig has been developed at the shops. The holding jig, shown in the illustration, consists of a low-pressure air-pump piston head, held in the chuck jaws and provided with a yoke made of ¾-in. by 2-in. stock, shaped as shown and bolted to the head. Three ⅝-in. set screws are provided to position the elbow, which is threaded onto a swivel block hinged to a post, adjustably bolted to the upper part of the piston head. This swivel block is capable of adjustment vertically by means of slotted holes, through which the two holding bolts



Special jig for holding booster steam- or exhaust-pipe ball joints while being machined

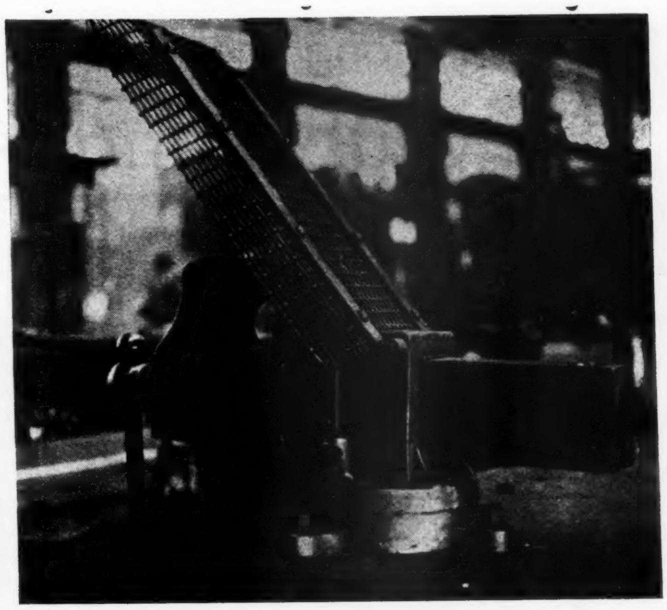
pass, and suitable adjusting screws. The ball end of the elbow is centered by means of a special ball-bearing center in the tail stock of the lathe.

A little study of the illustration will show that this holding fixture permits easy and accurate adjustment and centering of this awkward-shaped part. In addition, once this elbow is properly centered and the set screws tightened, it is firmly held in the correct position and is not likely to slip during the machining operation. Any preferred type of radius-turning attachment can then be applied to the lathe carriage and used for machining the ball shape.

Adjustable Bench-Vise Shield

SOME time ago the *Railway Mechanical Engineer* published an article describing a "screen shield for the bench vise." It consisted of a piece of front-end mesh attached to the back or side of the bench which prevented chips from flying when chipping was done at the vise. The shield shown in the illustration is attached to the vise, being secured by two ¾-in. studs tapped into the body of the vise as shown. When chipping is being performed or rivet or bolt heads are being removed from material placed in the vise the shield can be turned up in position as shown. When it is not required for use as a shield the screen can be lowered and will not interfere with any other type of material that it is desirable to place in the vise.

The shield is made from ordinary front-end mesh of



A removable bench-vise shield

the size desired and is riveted to two ½-in. by 1-in. strap-iron hinges.

Blacksmith Shop Tool Rack

TO afford a more convenient and systematic arrangement of tools at each blacksmith's forge the general foreman at one back-shop installed the type of rack shown in the photograph. The rack is made from ½-in. by 2-in. bar iron which is welded together. Provision is made on one side to insert the various types of tongs that are needed and on the other side for anvil inserts. A cooling tank is also provided under the rack.

A tool-rack, a table and a cooling tank, in one

A steel plate applied to the top provides a safe place for laying out blue-prints which the blacksmith is required to consult or can be used as a work bench instead of the usual table—the anvil.

NEW USE FOR OLD "HACKS."—The University of North Dakota has found a novel way to help students of more ambition than wealth. Half a dozen old railway cabooses have been turned into a dormitory unit and some 30 students are comfortably housed in them.

Among the Clubs and Associations

Toronto Railway Club.—W. H. Winterrowd, vice-president of the Lima Locomotive Works, discussed the Relation of the Locomotive to the Operating Income Account at the May 4 meeting of the Toronto Railway Club.

Northwest Car Men's Association.—O. E. Ward, superintendent of motive power of the Chicago, Burlington & Quincy, discussed Light Weight Railroad Equipment at the meeting of the Northwest Car Men's Association held on May 7 at St. Paul, Minn.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—The speaker at the May 10 meeting of the Car Foremen's Association of Omaha at Council Bluffs, Iowa, was K. H. Carpenter, general car foreman of the Missouri Pacific, who presented a paper on Maintenance of Passenger Equipment.

Car Foremen's Association of Chicago.—At the meeting of the Car Foremen's Association of Chicago, to be held at 8 p. m. on May 14 at the LaSalle Hotel, Chicago, W. E. Dunham, superintendent of the car department of the Chicago & North Western, will discuss Accident Prevention in the Car Department.

Canadian Railway Club.—"English vs. Canadian Standards of Construction of Locomotive and Car Equipment and Methods of Operation" is the title of a paper to be presented by W. Walker, acting superintendent of motive power and equipment of the Canadian National Railways, at the meeting of the Canadian Railway Club which will be held at 8 p. m. on May 14 at the Windsor Hotel, Montreal. This paper was the winner in the regular annual competition sponsored by the Canadian Railway Club among junior railway employees in Canada.

American Society of Mechanical Engineers.—The tentative program arranged for the semi-annual meeting of the A.S.M.E, which will be held at the Cosmopolitan Hotel, Denver, Colo., June 25 to 28, includes, among other subjects, papers on passenger tramways; smoke problems; heat engineering—covering air conditioning, experiences in burning pulverized lignite, and petroleum coke; and recent progress of high-speed light-weight railroad trains, with discussions by representatives of the Chicago, Burlington & Quincy and the Union Pacific—the new three-car articulated train units of which roads may be available for inspection during the meeting.

Purchases and Stores Division.—In accordance with a recommendation of the Federal Co-ordinator, the Purchases and Stores Division, American Railway Association, has appointed a special committee, to study purchasing methods. This committee, which consists of F. D. Reed, purchasing agent, Chicago, Rock Island & Pacific; A. C. Mann, vice-president and purchasing agent, Illinois Central; and C. E. Walsh, purchasing agent, Pennsylvania, is considering a plan to form regional boards of railway purchasing officers to review copies of all orders placed by railways for supplies and to study these orders to determine the extent of adherence to A. R. A. standards and specifications, the routing of railway material and the prices paid for material. The committee has recommended giving the plan a trial in one region by the formation of a committee of purchasing officers of not more than six railroads with offices in the city of Chicago, and authorizing this committee to act as the reviewing board during the trial period. ¶ The General Committee and Advisory Committee of the Division have decided that no annual meeting of the Division shall be held this year. Instead, a meeting of the General and Advisory committees will be held in Chicago June 8, at which the chairmen and members of subject committees will present completed recommendations, and at which the winners of the annual essay contest will present their papers. ¶ D. C. Curtis has been appointed chairman of a committee to study the proposed code of the bolt, nut and rivet industry.

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—T. L. Burton, Room 2205, 150 Broadway, New York.

Allied Railway Supply Association.—F. W. Venton, Crane Company, Chicago.

American Railway Association.—Division V.—Mechanical.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

Division V.—Equipment Painting Section.—V. R. Hawthorn, Chicago.

Division VI.—Purchase and Stores.—W. J. Farrell, 30 Vesey street, New York.

Division I.—Safety Section.—J. C. Caviston, 30 Vesey street, New York.

Division VIII.—Car Service Division.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Columet avenue, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

Railroad Division.—Marion B. Richardson, Room 332, 30 Church street, New York. Spring meeting, Denver, Colo., June 25-28.

Machine Shop Practice Division.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

Materials Handling Division.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

Oil and Gas Power Division.—Edgar J. Kates, 1350 Broadway, New York.

Fuels Division.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

Canadian Railway Club.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

Car Department Officers Association.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

Central Railway Club of Buffalo.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

Cleveland Railway Club.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meetings temporarily suspended.

Eastern Car Foremen's Association.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

International Railway Fuel Association.—T. D. Smith, 1660 Old Colony building, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha street, Winona, Minn.

International Railroad Master Blacksmith's Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boilermakers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately

Railway Car Men's Club of Peoria and Pekin.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

Railway Supply Manufacturers' Association.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Supply Men's Association.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

Toronto Railway Club.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

Western Railway Club.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

Machine Tool Survey Made for the Federal Co-ordinator

In an effort to determine to what extent modern machine tools might contribute to economies in locomotive and car maintenance a survey has recently been completed in a large railroad shop for the Federal Co-ordinator of Transportation by a group of machine-tool engineers, selected from member companies of the National Machine Tool Builders' Association. This survey, which was primarily a fact-finding study to produce basic data as to the savings which can be made by the replacement of obsolete machine tools with modern machines, is one of several projects under way by which it is expected that definite recommendations may eventually be made which will promote economies in railroad operation and maintenance. In making the machine-tool study in question no attempt was made to take into consideration the entire problem of locomotive and car repairs, but the investigation was confined solely to machine-tool operations.

Arch-Bar Trucks

Interchange Rule 3, section t, paragraph 3, provides that, effective January 1, 1936, cars with arch-bar trucks will not be accepted from car owners. For a number of years the Mechanical Division of the A. R. A. has sent out an annual questionnaire to all railroads and owners of private-car-line equipment and from the responses has tabulated the condition of freight cars as regards type of truck—arch-bar or cast-steel side frame. A statement showing the kinds of trucks on interchange freight equipment as of January 1, 1934, has just been issued. This includes for railroad owned equipment, 219 replies, 2,251,071 interchange freight cars owned or controlled, of which 780,762 cars, or 34.7 per cent, were equipped with arch-bar trucks. From private car lines 196 replies were received. These showed 294,546 cars owned or controlled, of which 121,595, or 41.3 per cent, were equipped with arch-bar trucks. Combining railroad and private car-line equipment, the statement shows 2,545,625 cars owned or controlled, of which 902,357, or 35.4 per cent, were equipped with arch-bar trucks.

During the past four years there has been a slow, but steady, decrease in the number of arch-bar trucks. The tabulation for January 1, 1930, showed 43.6 per cent of railway owned interchange freight equipment, 49.5 per cent of private-car-line equipment, and 44.2 per cent of all interchange equipment had arch-bar trucks.

Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of System	Builder
Boston & Maine and Maine Central	4	Diners	Ice	Rails Co.
	4	Comb. de luxe smok. cars	Ice	B. F. Sturtevant Co.
	9	de luxe coaches		
Erie	18	Pull. sleepers	Steam eject.	Safety Car Htg. & Litg. Co.
	14	Coaches		
	2	Parlor-buffet		
	2	Diners		
New York Central	6	Diners	Electro.-Mech.	Frigidaire-Westinghouse
	9	Coaches		
New York, New Haven & Hartford	50*	de luxe light-weight streamlined coaches	....	Gen. Elec.-Sturtevant
Pennsylvania	38†	Pass.	Ice	....
	18†	Comp.		
	23†	Comb. pass.-bagg.		
	30†	Diners	Mech.	Frigidaire
	299	Pull. sleepers	Ice	....
	26	Pull. parlor		

* These are new cars, the order for which has been placed with the Pullman-Bradley Car Corp. as noted in the P. W. A. item in the April issue. These cars, while radically different in design, will be operated, as far as possible as unit trains, but will be interchangeable with present equipment if occasion demands. The new coaches will be of aluminum and light weight materials, the weight per car being approximately 100,000 lb.
† Work being done at Altoona shops.

Identification Marking for Automobile Cars with Loading Racks

There are several thousand automobile box cars in service equipped with mechanical loading devices. In harmony with the expressed opinion of the Car Service Division that the movement of such cars would be facilitated if they were provided with identification marking and upon recommendation of the Committee on Car Construction the Mechanical Division of the American Railway Association has taken a letter ballot on the addition of the following note for Fig. 1, page 40, Section L, of the Manual:

"Note 13. For automobile box cars equipped with automobile loading racks a 3-in. white stripe is to be painted on the right-hand door, facing side of cars, extending full width of door, approximately 3 ft. above floor line, and immediately above this stripe the words "Auto Rack" are to be stenciled in white letters 2 in. high; this marking to be applied to both sides of car."

The proposition was approved and has been made effective immediately.

Basic Wage Rates To Be Restored Gradually

A compromise settlement of the railway wage controversy on the basis of a gradual restoration of the 10 per cent deduction now in effect was announced on April 26 by the Conference Committee of Managers and the Railway Labor Executives' Association after the labor organizations had previously declined to accept President Roosevelt's proposal that the present agreement be extended six months, and after Co-ordinator Eastman had withdrawn as Mediator. The agreement, proposed by the railroad committee and ratified by the general chairman of the labor organizations provides for restoration of one-quarter of

New Equipment

Car Orders

Road	No. of cars	Type	Builder
Alaska R. R.	10	Air-dump	Western Wheeled Scraper Co.
C. M. St. P & P. (see note)	2	Air-dump	Western Wheeled Scraper Co.
Chilean State Rys.	15	Coaches	Bethlehem Steel Corp.
D. L. & W.	350*	50-ton steel hopper	American Car & Fdry. Co.
	150*	50-ton steel hopper	Magor Car Corp.
Erie	50	50-ton bulk cement	Greenville Steel Car Co.
G. M. & N.	100*	Box	American Car & Fdry. Co.
	50* **	Box-car parts	
	50* **	Gondola-car parts	
U. S. Navy	2	50-ton box	Haffner-Thrall Car Co.
	3	50-ton flat	Haffner-Thrall Car Co.

Car Inquiries

Road	No. of cars	Type	Builder
Boston & Maine	21*	Suburban	....
	3*	Diesel rail-motor cars	....
C. of Ga.	200*	70-ton hopper	....
C. G. W.	500*	50-ton box	....
P. S. & N.	150	50-ton hopper	....
S. A. L.	10	Box-car underframes	....

Locomotive Orders

Road	No. of locomotives	Type of locomotive	Builder
Chilean State Rys.	10	2—8—2	Baldwin Locomotive Works
D. L. & W.	20*	4—8—4	American Locomotive Co.
	2*	600-hp. oil-elec.	General Motors Corp. (Winton Engine Co.)
	2*	600-hp. oil-elec.	Ingersoll-Rand Co.
Lehigh Valley	5*†	4—8—4	Baldwin Locomotive Works
U. S. Navy	2	300-hp. Diesel	American Locomotive Co.

Locomotive Inquiries

Road	No. of locomotives	Type of locomotive	Builder
B. & M.	5*	4—6—2	....
	5*	4—8—2 or 4—8—4	....
	1*	Diesel-switch.	....

* To be purchased with money loaned by the P. W. A.
** These cars are to be built in the shops of the G. M. & N.
† Two of these locomotives will be equipped throughout with Timken roller bearings on all axles, including driving axles. Timken roller bearings will be used on the engine trucks of all five locomotives.
Note: 50 coaches and 25 baggage-express cars, for which inquiry has been made, will be built in the shops of the C. M. St. P. & P. The money for this work has been loaned by the P. W. A.

the reduction July 1, one-half on January 1, 1935, and the remaining quarter on April 1, 1935.

The agreement stipulates that basic rates of pay until changed upon notice, as hereinafter provided, shall remain the same as under the agreement of January 31, 1932, as extended. The agreement also provides that no notices of changes in basic rates shall be served by any party upon any other party prior to May 1, 1935.

School of Air Conditioning

A SCHOOL of air conditioning has been organized at Kansas City, Mo., by employees of the Kansas City Pullman Company, Kansas City Terminal Company, Rock Island, Santa Fe, Kansas City Southern, Union Pacific, Missouri Pacific and Burlington. The total enrollment is 145 men, and classes, divided into four groups, are held each night in the week except Sunday. There are also classes on Monday, and on Thursday afternoons, for the benefit of the men who will have to service the air-conditioned cars that come into the station or yards at night. The course of study will include terms and definitions, study of the psychrometric chart, coefficient of heat transfer, sensible and latent heat, sun effect on steel cars, estimating cooling and heating requirements, cooling and heating coils, pumps and motors, air filters, blowers, ducts and outlets, ice bunker system, mechanical refrigeration system, steam-generating system and precooling of cars. The school was arranged for through the work of E. M. Eardley and E. O. Grimm, of the Pullman Company. The instructor is M. W. Pehl, air-conditioning engineer, formerly connected with National Air-Control Company, New York.

P. W. A. Loans to Railroads

CONTRACTS signed or allotments made since the publication of the April *Railway Mechanical Engineer* are as follows:

Baltimore & Ohio.—An additional allotment of $900,000 has been made to the B. & O. which will enable it to put two high-speed light-weight trains in operation, one of which will be the first streamline train to be operated by steam power, while the other will be operated by an 1,800-hp. Diesel-electric engine, and both of which will be capable of 90 to 100 m.p.h., although it is not anticipated that it will be necessary to operate that fast on regular schedules. The amount of the loan will be used to purchase the Diesel-electric engine and 16 passenger coaches. The steam locomotive is a 4-4-4 type Class J-1 locomotive, which will be converted by the B. & O. at its own shops.

Both locomotives and cars have been designed to offer the least resistance to the air at high speeds, although the design is considerably different from that of the high-speed trains recently put into service by the Union Pacific and the Chicago, Burlington & Quincy, and the cars will not be as radically different from the standard passenger cars. Each will be an independent unit with two four-wheeled trucks. The superstructure of the cars in one train will be of U. S. S. Cor-ten, a corrosion-resistant, high-tensile steel, while that of the other will be aluminum alloy, thus enabling the B. & O. to test the relative merits of both materials as well as to determine whether steam or Diesel-electric power is the better for the service in which these trains are to be used. Each train will consist of six cars and locomotive, four cars being held in reserve. Each will include a combination passenger-baggage car, two reclining seat cars, a combination lounge-dining car, a chair car and an observation chair car. The three coaches will seat 176 passengers, while the two chair cars will seat 32 passengers each.

Both cars and locomotives have been designed to lower the center of gravity by a reduction in the overall height of the cars and the reduction of the weight of the superstructure.

All cars will be completely air conditioned, permitting the windows to be set flush with the sides so that there wll be no recesses in the car sides to create air resistance. The usual roof ventilators also will be elminated, further reducing resistance. The rear end of each observation car will be tapered and rounded to reduce the rear end vacuum drag.

The steam locomotive will carry a jacket over the boiler to cover the air pumps, steam dome, piping and other projections that multiply air resistance on locomotives designed before air resistance was recognized as an important factor.

The total weight of the engine will be 213,800 lb., of which 99,800 will be on the four driving wheels. The drivers will be 7 ft. in diameter. Steam pressure will be 350 lb. per square inch, approximately 100 lb. higher than the pressure carried by most locomotives.

Delaware, Lackawanna & Western.—A contract has been signed for a loan of $3,623,000 to this road for the purchase of the cars and locomotives listed in the New Equipment table. A contract covering a loan of $1,043,000 to the Lackawanna to enable it to repair engines and cars that it already owns is in process of preparation.

Great Northern.—An allotment of $850,000, in addition to the $4,935,000 contract which has already been signed as noted in the April issue, has been made for the Great Northern. The new allotment will be used to apply steel underframes and make other improvements on 650 refrigerator cars in the Great Northern's shops at St. Cloud, Minn., where about 330,000 man-hours of additional employment will be provided for the company's shop forces.

Interstate.—A contract for a loan of $250,000 enables the Interstate to give its shop forces at Andover, Va., 130,000 man-hours of additional employment in rebuilding 500 coal cars.

Lehigh Valley.—The contract signed for the Lehigh Valley totals $600,000, which will be used for the purchase of the locomotives listed in the New Equipment table.

Midland Continental.—A contract for an allotment of $36,000 to the Midland Continental has been signed. This amount will be used in connection with the purchase of a new Diesel-electric locomotive. This locomotive will cost $52,000. The balance required above the $36,000 will be supplied by the railroad.

New York, New Haven & Hartford.—Contracts for loans of $1,300,000 for rail and $2,300,000 for equipment have been signed for this road.

Contracts for the purchasing and laying of new rail, fastenings, switches, etc., have been signed for the Maine Central ($313,000) and the New York Central ($2,500,000).

Inquiries and orders placed for equipment to be purchased with money loaned by the P.W.A. are shown in the New Equipment table elsewhere on these pages.

Supply Trade Notes

L. G. SEVER, assistant to the president of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., has been appointed vice-president and manager of sales.

E. W. BACKUS, western representative of Standard Equipment, Inc., New York, with headquarters at Chicago, has been appointed chief engineer in addition to his present duties.

H. D. BINKS, who was president of the Binks Spray Equipment Company, Chicago, until 1929, has organized the H. D. B. Corporation, with general offices and plant at 900 North Spaulding avenue, Chicago, to manufacture spray guns and allied equipment.

JOHN L. RANDOLPH, formerly vice-president of the Franklin Railway Supply Company, Chicago, has organized John L. Randolph & Son, with offices at 1017 McCormick building, Chicago, to engage in the sale of railway supplies.

JOHN E. DIXON, vice-president in charge of sales of the Lima Locomotive Works, Incorporated, since its reorganization in 1916, has been appointed vice-president in charge of both sales and engineering. Mr. Dixon's headquarters will continue to be at New York.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, at its annual meeting on April 11, elected two new directors, A. L. Humphrey, chairman of the board of the Westinghouse Air Brake Company, and H. S. Wherrett, president of the Pittsburgh Plate Glass Company. At the same meeting five other directors now serving on the board were re-elected.

H. S. COLBY has been appointed general sales manager of the Combustion Engineering Company, New York. Mr. Colby, until recently, was president of the Air Preheater Corporation. For the past 20 years he has been engaged in the design, production and sales of steam generating equipment involving boilers, stokers, pulverizers, economizers and air preheaters.

THE DAVENPORT BESLER CORPORATION has become the successor to the Davenport Locomotive & Manufacturing Corporation. at Davenport, Iowa.

THE AIR REDUCTION SALES COMPANY, New York, will act as distributor of the new low melting point brazing alloy "Sil-Fos" made by Handy & Harman. This alloy is noticeable for its low melting and flows freely at 1,300 deg. F., or from 300 to 600 deg. lower than ordinary brazing alloys used for brass, bronze, copper, or other base metals.

E. A. TURNER, for the past six years patent solicitor of The Standard Stoker Company, Inc., has been appointed also assistant to the president with headquarters at New York. Prior to his association with The Standard Stoker Company, Mr. Turner was development and patent engineer of the Locomotive Stoker Company.

WILLIAM H. WHITE, until recently associated with the Graham-White Sander Corporation, Roanoke, Va., has been appointed southeastern representative of the T-Z Railway Equipment Company and the Morris B. Brewster Company, Chicago, with headquarters at Roanoke.

BATT L. SPAIN, who has been for the past 24 years with the General Electric Company at the West Lynn, Mass., works as manager of turbo-blower sales, is now connected with the Ingersoll-Rand Company as manager of the turbo-blower department. He will be located at the general offices, 11 Broadway, New York. The transfer of Mr. Spain follows the acquisition of the turbo-blower business of the General Electric Company by the Ingersoll-Rand Company.

J. H. BENDIXEN, vice-president and manager of sales of the Bettendorf Company, Bettendorf, Iowa, has been elected chairman of the board and first vice-president and manager of sales, and E. J. Bettendorf, secretary and treasurer, has been elected president, to succeed J. W. Bettendorf, de-

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ceased. Other officers elected are: W. E. Bettendorf, secretary; J. L. Miclot, assistant secretary; and A. J. Bettendorf, assistant treasurer.

R. B. MILDON, recently in charge of the stoker department of the Westinghouse Electric & Manufacturing Company, has been elected vice-president in charge of the operations of marketing, engineering, manufacturing and service in connection with the products of the South Philadelphia, Pa., works, where he will have his headquarters.

THE GATE CITY IRON WORKS, Omaha, Neb., has been appointed distributors of Enduro stainless steel and Toncan copper molybdenum iron; the Barde Steel Company and the Doran Company, both of Seattle, Wash., and Earle M. Jorgensen Company, Los Angeles, Cal., have been appointed distributors of Enduro stainless steel, according to a recent announcement of the Republic Steel Corporation, Youngstown, Ohio. Enduro is produced by the Central Alloy division of Republic, Massillon, Ohio.

Frank H. Cunningham has been appointed western sales manager of Graham-White Sander Corporation with headquarters at Chicago. Mr. Cunningham received his technical training at Virginia Polytechnic Institute and after an apprenticeship on the Norfolk & Western served as assistant engineer of tests and supervisor of locomotive stoker performance. He then went to the Standard Stoker Company as assistant general manager and later to the Franklin Railway Supply Company as district service manager.

THE RAILWAY CAR APPLIANCES ASSOCIATION, organized as a division of the Fabricated Metals Products Manufacturing and Metal Finishing and Metal Coating Industries by the railway car appliances industries, has selected the following members as its code authority: William E. Sharp, president of the Grip Nut Company, Chicago; S. L. Beymer, secretary-treasurer of the Hutchins Car Roofing Company, Detroit, Mich.; G. N. DeGuire, assistant to the president, Locomotive Firebox Company, New York; A. C. Moore, president, Chicago Railway Equipment Company, Chicago; and H. S. Kimball, Fabricated Metal Products Federation, Washington, D. C. Elmer M. Naylor, vice-president, Naylor Pipe Company, Chicago, is the administration member of the code authority.

A. L. CLARK has been elected president of the American Brake Shoe & Foundry Company of California, San Francisco, Cal., to succeed Thomas Finigan, deceased. Mr. Clark has been actively engaged in the foundry business since 1902, at which time he entered the employ of The American Brake Shoe & Foundry Company as chief clerk at its Mahwah, N. J. plant, having previously been in the employ of the Sterling Iron & Railway Company as storekeeper. He later served in the accounting department and became traveling auditor, and in 1905 entered the operating department as assistant to the general superintendent. In 1909 he was appointed superintendent of the Norwood, Mass., plant, and three years later superintendent of the new Chicago plant. In 1913 he was promoted to the position of general superintendent of western foundries, and during the war period was acting works manager. In 1921 Mr. Clark was appointed general manager of The American Brake Shoe & Foundry Company of California, and in 1922 was elected vice-president, which position he continued to hold until his election as president.

THE CHILLED CAR WHEEL INDUSTRIES, through the Association of the Manufacturers of Chilled Car Wheels, has elected the following as members of its code authority: D. H. Sherwood, president of the association and vice-president of the Maryland Car Wheel Company; W. F. Cutten, president of the Southern Car Wheel Company; J. L. Kilpatrick, president of the Albany Car Wheel Company and the Reading Car Wheel Works; E. P. Waud, vice-president of the Griffin Wheel Company and president of the Cleveland Production Company; and J. M. Keller, manager of foundries of the American Car & Foundry Company. Horace B. Horton, treasurer of the Chicago Bridge and Iron Works, Chicago, has been appointed administration member of the code authority by the N.R.A.

Obituary

I. H. BOWEN, railroad department representative of the Dearborn Chemical Company, at Denver, Colo., died recently.

CHARLES E. HALE, for many years connected with the sales organization of the Baldwin Locomotive Works, died at Philadelphia, Pa., on April 16.

BENJAMIN F. OTLEY who retired as president and general manager of the Otley Paint Manufacturing Company, Chicago, in 1918, died in that city on April 5, following a cerebral hemorrhage.

JOSEPH H. KUMMER, general sales representative of the Fort Pitt Malleable Iron Company, with headquarters at Pittsburgh, Pa., died of heart failure in New York on March 18. Mr. Kummer was born in Detroit, Mich., on July 2, 1881, and at an early age became associated with the Fort Pitt Malleable Iron Company.

ALFRED J. JUPP, a vice-president of the Lunkenheimer Company, Cincinnati, Ohio, died suddenly in Roosevelt Hospital, New York, on April 10, while on a business trip. Born in Cincinnati on June 25, 1875, Mr. Jupp entered the employ of the Lunkenheimer Company in May, 1890. In 1896 he was made New York representative, returning to the home office in Cincinnati in 1913. Mr. Jupp was active in the Manufacturers' Standardization Society and also contributed the greater part of his time during recent months to code work in the valve and fittings industry.

WILLIAM HARTMAN WOODIN, formerly president of the American Car & Foundry Company and chairman of the Board of directors of the American Locomotive Company, and until his resignation on January 1, 1934, secretary of the treasury in the cabinet of President Franklin D. Roosevelt, died at a hospital in New York on May 3. Mr. Woodin was born at Berwick, Pa., on May 27, 1868. He was a descendant of a family which has been associated with railway car building practically since the inception of that industry in this country. In 1849 his grandfather, after whom he was named, entered a partnership with Mordecai W. Jackson to establish at Berwick, Pa., a foundry under the firm name of Jackson & Woodin for the manufacture of stoves, plows, iron pipe and other foundry products. In 1861 this business was extended to include the manufacture of cars and in 1872 it was absorbed by a new company known as the Jackson & Woodin Manufacturing Company. This latter was one of the firms which in 1899 were merged to form American Car & Foundry Company. Mr. Woodin received a technical education at the Columbia University School of Mines which he attended with the class of 1890. Upon leaving college he entered the shops of the Jackson & Woodin Manufacturing Company at Berwick and in 1892 was appointed general

W. H. Woodin

superintendent of that plant. Three years later, in 1895, he was elected vice-president and his promotion to the presidency came in 1899. With the merging of the plant into the American Car & Foundry Company in the latter year, Mr. Woodin was appointed district manager of the Berwick plant. He next became assistant to the first vice-president of the new company and in 1902 he was appointed a director and assistant to the president, having general direction of the company's affairs under President Frederick H. Eaton, whom, on February 1, 1916, Mr. Woodin succeeded in the presidency. Mr. Woodin first became president of the American Locomotive Company in December, 1925, succeeding the late Andrew Fletcher. In May, 1926, however, he temporarily relinquished the position and was succeeded by Frederick F. Fitzpatrick, former president of the Railway Steel-Spring Company. After the death of Mr. Fitzpatrick in November, 1927, Mr. Woodin was again the American Locomotive Company's president until April, 1929, when, remaining as chairman of the board, he was succeeded in the presidency by William C. Dickerman. Mr. Woodin also held offices in companies affiliated with the American Car & Foundry Company and the American Locomotive Company.

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Personal Mention

General

G. C. Seidel has been appointed superintendent of motive power of the Missouri & North Arkansas, with headquarters at Harrison, Ark.

J. J. Prendergast, assistant mechanical superintendent of the Texas & Pacific, has been appointed acting mechanical superintendent, with headquarters as before at Dallas, Tex.

M. W. Hassett has been appointed assistant superintendent of equipment of the New York Central (Buffalo and East) with headquarters at New York. Mr. Hassett was formerly assistant superintendent of motive power, which position has been abolished.

E. C. Richards has been appointed assistant superintendent of equipment of the Michigan Central, with headquarters at Detroit, Mich. Mr. Richards was formerly superintendent of rolling stock of the Michigan Central at Detroit, which position has been abolished.

B. F. Kuhn has been appointed assistant superintendent of equipment of the New York Central (West of Buffalo) and the Ohio Central Lines, with headquarters at Cleveland, Ohio. Mr. Kuhn was formerly assistant superintendent of motive power of these lines, which position has been abolished.

James H. Wilson, chief electrician of the Norfolk Southern with headquarters at Norfolk, Va., has been appointed chief mechanical inspector and assistant to superintendent of motive power, with the same headquarters. Mr. Wilson will assume the duties of the late Herbert Smith Fentress, general car inspector.

J. W. Senger has been appointed assistant superintendent of equipment of the New York Central (West of Buffalo) and the Ohio Central Lines, with headquarters at Cleveland, Ohio. Mr. Senger was formerly superintendent of rolling stock of these lines at Cleveland, which position has been abolished.

W. J. O'Brien has been appointed district assistant superintendent of equipment of the Ohio Central Lines of the New York Central, with headquarters at Columbus, Ohio. Mr. O'Brien was formerly district superintendent of motive power and rolling stock of the Ohio Central Lines at Columbus, which position has been abolished.

A. E. Calkins has been appointed superintendent of equipment of the New York Central (Buffalo & East), with jurisdiction over the motive power and rolling stock departments (other than shop operation), with headquarters at New York. Mr. Calkins was formerly superintendent of rolling stock at New York, which position has been abolished.

J. A. Brossart has been appointed assistant to general superintendent of rolling stock, with jurisdiction over freight and passenger-car shop operations, of the New York Central, the Michigan Central and the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at New York. Mr. Brossart was formerly superintendent of rolling stock of the C. C. C. & St. L. at Indianapolis, Ind.

R. M. Brown has been appointed assistant to general superintendent of motive power of the New York Central, the Michigan Central and the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at New York. Mr. Brown was formerly superintendent of motive power of the New York Central at New York, which position has been abolished.

J. F. Jennings has been appointed superintendent of equipment of the Michigan Central, with jurisdiction over the motive power and rolling stock departments (other than shop operation), with headquarters at Detroit, Mich. Mr. Jennings was formerly superintendent of motive power of the Michigan Central at Detroit, which position has been abolished.

Jos. Chidley has been appointed superintendent of equipment of the New York Central (West of Buffalo) and the Ohio Central Lines, with jurisdiction over the motive power and rolling stock departments (other than shop operation), with headquarters at Cleveland, Ohio. Mr. Chidley was formerly superintendent of motive power of these lines at Cleveland, which position has been abolished.

E. M. Wilcox has been appointed superintendent of equipment of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with jurisdiction over the motive power and rolling stock departments, with headquarters at Chicago. Mr. Wilcox was formerly master car builder of the New York Central (West of Buffalo), the Michigan Central, the Indiana Harbor Belt and the Chicago River & Indiana, which position has been abolished.

Master Mechanics and Road Foremen

P. R. Frisbee has been appointed road foreman of engines of the Buffalo division of the Erie.

L. D. Burdell has been appointed road foreman of engines of the Susquehanna division of the Erie.

W. G. McClure has been appointed road foreman of engines of the Kent division of the Erie, with headquarters at Marion, Ohio.

W. P. Hartman, fuel supervisor of the Atchison, Topeka & Santa Fe at Amarillo, Tex., has been promoted to the position of master mechanic, with headquarters at Slayton, Tex.

J. W. McCarthy, road foreman of engines of the Susquehanna division of the Erie, has been appointed chief road foreman of engines of the Susquehanna and Delaware divisions.

J. D. Sheehan has been appointed master mechanic of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana and the Chicago Junction Railway, with headquarters at Chicago. Mr. Sheehan was formerly master mechanic of the New York Central (West of Buffalo), Elkhart, Ind.

Car Department

E. H. Burgess has been appointed inspector of air conditioning equipment of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with headquarters at New York.

C. Houser has been appointed general car foreman of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with headquarters at Chicago. Mr. Houser was formerly foreman inspector of the Indiana Harbor Belt at Gibson, Ind.

F. J. Hill has been appointed general supervisor of car electric equipment of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with headquarters at New York. Mr. Hill was formerly chief electrician, car department of the Michigan Central at Detroit, Mich.

Shop and Enginehouse

C. R. Swanson, a machinist on the Union Pacific at North Platte, Neb., has been promoted to the position of drop pit foreman.

Austin R. Snyder, a machinist on the Union Pacific at North Platte, Neb., has been promoted to the position of night enginehouse foreman.

Albin C. Petterson, night enginehouse foreman of the Union Pacific at North Platte, Neb., has been promoted to the position of day enginehouse foreman.

Walter R. Lye has been appointed superintendent of shops of the New York Central (West of Buffalo), with headquarters at Collinwood, Ohio. Mr. Lye was formerly district superintendent of motive power of the same lines, which position has been abolished.

Obituary

W. H. Dooley, formerly superintendent of motive power of the Southern, died on April 30.

Herbert Smith Fentress, general car inspector of the Norfolk Southern, with headquarters at Norfolk, Va., died of a cerebral hemorrhage at his home in Norfolk, on March 13, at the age of 68.